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A WINGED SUBMARINE DESTROYER

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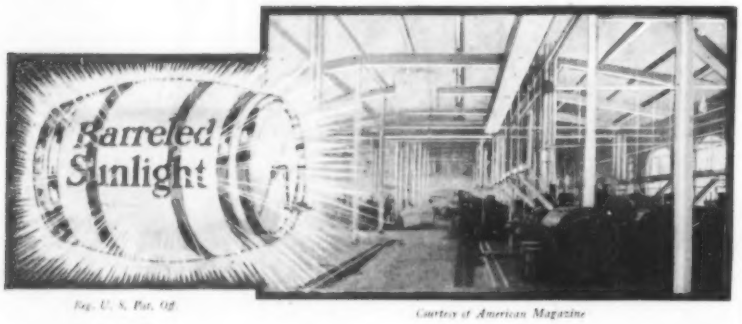
Could Miss Tarbell say this of your factory?



Reg. U. S. Pat. Off. Courtesy of American Magazine

MISS Ida M. Tarbell, the noted industrial investigator, visited the Pilgrim Laundry in Brooklyn—one of the many progressive plants painted with Rice's Gloss Mill-White. In the course of an article in the American Magazine, she said:

> "Within, it is a thing of glass and white paint. Strength, sanitation, air, light, proof against fire—these seem to have been the main ideas in designing the building. The result is a structure which in certain fundamentals to good health goes farther than any public building—theatre, church, office, shop—that I personally have seen."

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Rice's Granolith

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THE NATIONAL WEEKLY

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SEVENTY-FIRST YEAR

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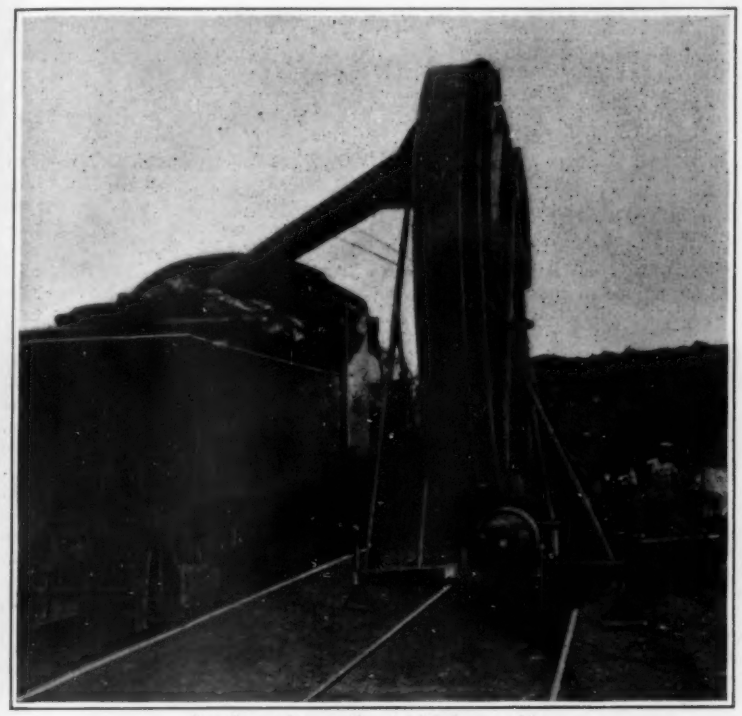
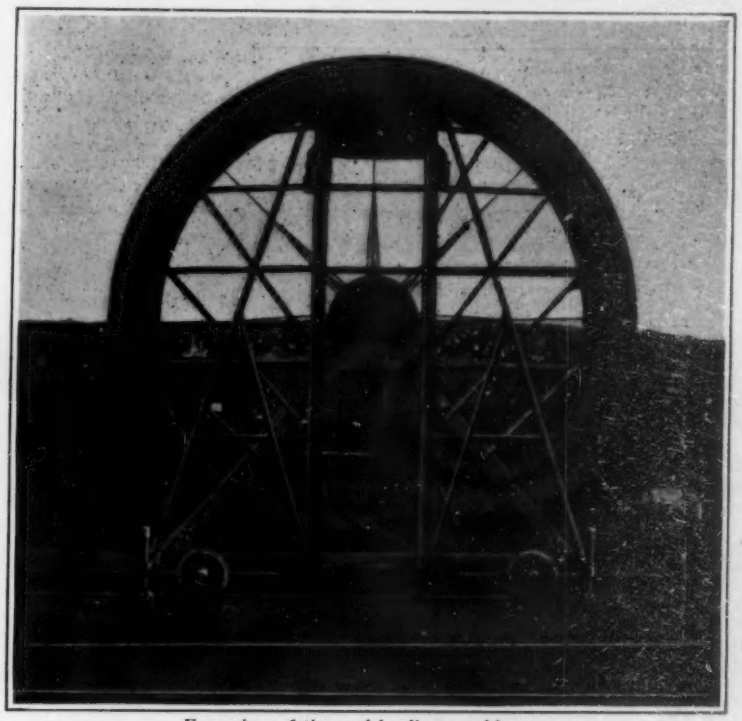


Loading a locomotive tender by machine.



Face view of the coal loading machine.

Italian Machine for Loading Coal Tenders

DIFFERENT methods are employed for loading coal upon locomotive tenders, and one of these consists in a large structure lying across several tracks at once so as to drop the coal through hoppers into the tender, the coal being brought to the spot by means of conveyors. Such apparatus can be fixed or movable. Another method is the use of lifting cranes mounted upon a railroad car truck. We wish to speak of a new apparatus for this purpose known as the Schilhan wheel, which is now in use at the main railroad depot at Rome. It has several advantages, such as a quick loading of the coal and general good working, besides affording a compact layout which is built at small expense and can be readily transported.

Our photographs represent the front as well as the side view of the apparatus, and it is made up essentially of a four-wheel truck which is adapted for running on a standard gage railroad track, upon this truck being mounted the coal elevating device in the shape of a wheel of large diameter. The wheel is made up of a hollow plate iron rim having the concavity turned toward the center, this rim being held to the middle part next the shaft by a set of light spokes, so that the wheel as a whole is able to run upon its bearings. These latter are upheld by a pair of structural iron bars, which are attached to the framework of the rolling truck. Within the hollow rim of the wheel are placed a number of cross partitions in inclined position so as to divide the available space into a series of equal chambers or buckets. In this way the wheel is constructed somewhat like a millwheel, except that the chambers or buckets lie around the inside instead of the outside. But the chambers are also closed on the inside, at least for most of their course, by the use of an inner fixed plate iron cylinder which lies about flush with the edges of the buckets. However, this circular rim is not continuous, for it is interrupted at the bottom part in order to be able to load the coal into the rotating wheel, and also at the top for discharging the coal.

The coal is easily loaded into the wheel by the use of a sloping platform leading down to the ground, and the coal trucks of the usual small size are run up the platform and dumped into the lower part of the wheel. As the wheel revolves, the coal is brought to the top and falls from the buckets into a suitable chute which is fixed to the framework of the device. The coal chute has the proper length so as to allow the coal to drop into the tender of the locomotive which lies upon an adjoining track. In this way the coal is rapidly elevated by the regular rotation of the wheel. Around the periphery of the wheel will be seen a geared portion of large diameter, which engages with a pinion placed at the lower part, and at one end of the truck is mounted a small electric motor for driving the pinion, and thus a continuous rotation of the large wheel is kept up at the desired speed. At each end of the truck is a cross-bar carrying a pair of screw jacks, so that the apparatus can be lifted somewhat off the track and made to rest in a fixed position at these four points when it has been properly brought opposite the tender. In the present instance, the small coal trucks or cars used for the loading have a capacity of 250 pounds each, and they are brought in turn up the sloping way so that four cars are dumped into the wheel while it makes one revolution, this during 40 seconds, and the amount of coal fed in per revolution of the wheel is thus 1,000 pounds.

The diameter of the wheel in this apparatus is about 18 feet and the size of the electric motor, 5 horse-power. It will load on an average one ton in 2½ to 3 minutes when the small cars are already loaded, or in 5 minutes if the cars need to be loaded during the maneuvers. Expense for power in the shape of electric current for the motor is about 0.15 kilowatt-hour per ton of coal.

In order to compare the results given by the present device with other apparatus for rapid loading of coal, the Italian railroad administration put in service two different types of electric crane. One of these is in operation at Florence, while the second type is similar to the ones employed on the Prussian railroads, and was installed at Naples. Each of these cranes is mounted upon a railroad truck and uses one electric motor for lifting the load and a second for rotating the crane on its pivot. Coal is brought under the crane on small cars running on light tracks and containing from 1,000 to 1,500 pounds, the car body being lifted by the crane and dumped into the tender. By this means a ton of coal is loaded on the tender in 4 minutes where the small cars are ready loaded, or in 8 minutes where they are loaded during the operation. Five men are needed in this case, and power used per ton of coal is 0.08 kilowatt-hour. But in spite of the larger amount of power taken by the Schilhan wheel, it is found to have several advantages over the use of cranes. In fact, it makes a better speed in loading the coal on the tenders and needs a less number of men to run it.

Electric Starter and Other Statistics.—No less than 261,860 cars were equipped with electric lighting and starting systems during 1914, out of a total production of 611,695 cars. The value of this equipment exceeded $10,000,000. The total wholesale value of the 611,695 cars was $380,000,000, which figures out an average value of $621.50 per car, dealer's price. An idea of the quantities of raw materials used up in the manufacture of motor cars in 1914 in this country may be obtained from the following partial list: Steel, 670,000 tons; aluminium and alloys, 4,020 tons; brass, 2,141 tons; hair for upholstery, 1,068 tons; moss, 2,050 tons; hides, 67,232, on the bais of one third hide per car, where real leather was used; artificial leather, 3,280,000 square yards; upholstery fittings, $917,542 worth; burlap, 6,560,000 yards; top materials, 11,405,250 yards, valued at $2,447,780; manufactured cotton in tires on new cars only, 7,950 tons; celluloid, 300,000 pounds; rubber and compounds, 9,338 tons; hinges, 2,446,780 pairs; door catch fittings, 2,446,780; carpet, 489,356 square yards; linoleum, 642,908 square yards; boards for floors, wheels and bodies, 8,450,000 running feet.

The National Aeroplane Fund

SUBSCRIPTIONS to the National Aeroplane Fund now total $37,001. A contribution of $10,000 comes from the prominent giver who was the first to donate $1,000 to the cause. She is greatly interested in the subject of national defense and considers the formation of aviation corps in the militia of the utmost importance. Her effort is to meet as far as possible the conditions created by the Navy's inability to keep its promise to supply aeroplanes to the Naval Militia of twenty-three States. The $10,000 provides an aeroplane with a course of training for two officers and two mechanics, the cost of which is estimated as follows: An aeroplane of standard type, capable of passing the regular military tests $7,500. A course of training for two officers and two mechanics, at $400 each, $1,000. Renting hangars and general, $900. Having two officers and two mechanics insures the development of aviation corps, whereas only one of each might result in crippling the corps in the event of the officer or mechanic retiring or in any way discontinuing his connection with the National Guard. Mr. Emerson McMillin, the banker, will add a 10 per cent bonus to all subscriptions up to the sum of $500,000 sent into the National Aeroplane Fund. Besides the offers of $10,000 and $7,500 presented by a sportsman, the Curtiss Aeroplane Company, Buffalo, N. Y., has presented the Naval Militia of New York, through the Aero Club of America, with a flying boat, and a course of training for two officers of that organization, who are now learning to fly at the Curtiss School.

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contribution will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

Wars, Ancient and Modern

COULD one, on the following considerations, base an opinion worth while as to how long the present world conflict can last: This war is probably unprecedented in history in the number of men engaged. Our civil war song ran, "We are coming, Father Abraham, three hundred thousand strong;" and our forbears thought that "a mighty host," as indeed it was. But Germany alone, in area something about one tenth that of our Northern States, has been furnishing at least ten fold those three hundred thousand men, already used up or now fighting or in reserve. Napoleon's mightiest army, that which was dissipated in and after Moscow, exceeded somewhat two hundred thousand men; for that number of Frenchmen one must now read in excess of two million. What a handful were Wellington's troops to those English now fighting or in reserve. Italy's forces are computed to exceed at least a million. All these estimates are surely conservative, possibly to the point of error. One reads that up to February 15th last some six million men have been put out of action (killed, wounded or missing—and for missing one can generally read "killed") in the various European spheres of campaigning.

Used up, or fighting, or in reserve! And of what quality are now in large part those reserves? It is the pitifullest thing in this most pitiful of all wars, the pictures one sees of the adolescents—the youths not much more than parted from their mothers' sides, that are now in training. Napoleon wanted no recruits under twenty-two. In 1809 he had to take from exhausted France what he could get, and half his army were under twenty; wherefore, all the hospitals his side of Vienna were packed with his sick, while his lines of march were strewn with his incapacitated. Raglan, in the Crimea, though terribly in need of reinforcements, preferred to wait rather than have "lads" sent him; "the last were so young and inexperienced that they fell victims to disease and were swept away like flies." And, on the other hand, are those pictures of men over forty who have been enrolled or have been ordered to prepare for the call. Bald, gray-templed, with pouching under lids, men with undistributed middles, as the logicians say; men in whom the degenerations are latent and bound to flourish like life-throttling weeds under such conditions as now obtain in the European trenches. These men, living temperately and under peace conditions, would probably attain their three score or three score and ten or even four score. But now how rapidly and how surely must they succumb to their rheumatisms, pneumonias, kidney, heart and liver affections; how long can now their uncertain arteries serve them? How much of an encumbrance rather than a strength are such men likely to be to their commanders? True, nations at war will continue the struggle long after the term of their apparent exhaustion is reached. But, considering the unprecedented extravagance of the human fighting material now obtaining, where is there to be found anywhere any remnant of such material that can last beyond the coming summer?

In that immortal history which Gibbon gave the world in 1781 he wrote: "If we review this general state of the imperial forces; of the cavalry as well as infantry; of the legions, the auxiliaries, of the guards, of the navy; the most liberal computation will not allow us to fix the entire establishment by sea and by land at more than four hundred and fifty thousand; a military force which, however formidable, was equaled by a monarch of the last century, whose kingdom was confined within a single province of the Roman Empire." Such was the force of an empire which civilization has ever considered the most militant in history, through the many centuries of whose existence its Temple of Janus was but twice closed; such was its force at a time when that mightiest of empires comprised practically all the then known world, from Britain and the Danube's sources south to Ethiopia, from the Western Ocean—the Atlantic—to the Euphrates; an area exceeding one million, six hundred thousand square miles of the most fertile and probably the most populous regions then known. And Gibbon further pregnantly observed regarding the era of Louis XIV: "It must be remembered that France still feels that extraordinary effort." If Gibbon was right, what centuries will it not take all Europe to regain the life and the vitality this cosmic struggle is now costing her.

Some Amateur Prophecies

PROPHECY is an occupation which is largely discredited. We all like to read prophecies: we all find a fascination in the picture the prophet unrolls before us, whether it is a purely imaginative effort like "The Time Machine" of Mr. H. G. Wells, or whether it professes to be a strictly inevitable deduction from such facts as the rate of consumption of the world's coal supply. But, having read the prophecy, we do not for an instant believe it; we have a conviction which cannot be shaken that "something will turn up" which will reduce the prophecy to idle words. The only thing we really believe about the prophet is that he will look foolish after the event.

Nevertheless, although well aware of the dangers we run, we are tempted to enumerate certain changes which appear to us as inevitable consequences of the war now raging in Europe. We can only discuss such consequences as remain unaffected whether Germany or the Allies are victorious, or whether the war is declared to be, for all practical purposes, a draw. At the present stage of affairs it is easier to predict what will happen after the war has ended than it is to predict how the war will end.

In the first place, whether Germany emerges victorious, moderately defeated, or overwhelmingly crushed, the fact remains that she has taught the world a very valuable lesson. She has taught the world the importance of the obvious. Other countries are learning, apparently for the first time, that if you are going to fight artillery battles it is quite helpful to have artillery; that if you wish to apply science to warfare, it is even better to employ scientific men than professional politicians. In England this last point has just been realized and a Board of Inventions has been created. In America something of the same kind is being instituted. Presently every country in the world will realize that there is some curious connection between science and scientific appliances, and every country will have its equivalent to a Board of Inventions.

Intelligence, once awakened, may go far. The same piercing insight may show us that many things, besides war, depend on science, and it may be that scientific men will be paid to look into these things. It is probable that, after the war, English inventors will not take their inventions to Germany. There will, of course, be plenty of other countries for them to go to, but it may come to pass that the English will show a disposition to profit itself by its own productions.

We venture to think that science will, in a measure, come into its own. We say "in a measure" because the lesson is not yet completely learnt. The English Parliament recently rescinded a vote of $125,000 for medical research on the grounds that so much money could not be diverted from strictly war purposes. England has, up to the present, spent about five thousand million dollars on the war and contemplates spending another five thousand million.

This mention of England's expenditure brings us to our second prophecy. It is fairly evident that, after the war, whoever wins, Europe will be in a comparative bad way, financially. Europe will want to raise money, and the only possible ministering angel is America. The financial center of the world will shift from London to New York. America will become the home of material prosperity in its most acute form, and it will run the dangers that material prosperity brings. To judge from the state of England before the war, great riches are attended by the unreasoning self-complacency which may drift to a disastrous awakening.

The second point reinforces the first, for owing to Europe's comparative poverty, it will be necessary for it to provide things economically, that is, by scientific as opposed to wasteful methods.

So far, then, we have deduced a state of affairs where science is taken more seriously all over the earth than it has been hitherto, and where America, and not England, is the great money-lender of the world. It is obvious that from these two points a great many others may be deduced. The increased importance of science will, we believe, be wholly to the good. This war is the end of an age, the age of haphazard.

There are many who think that this war will be followed by a conference of all nations, by the establishment of a super-police organization for the suppression of wars throughout the world. It is a consummation devoutly to be wished, but we are not sufficiently optimistic to include it definitely among our prophecies.

A more certain thing, and a very hopeful one, we consider to be the universal discrediting of professional politicians which already largely exists, and which post-war revelations cannot fail to render intense. Throughout the European countries at war, the politicians, as a class, have not made good. In a business house, when a man does not make good, he is presented with a well-known alternative. It is possible that the same stringent rule will be applied to the politicians, for the welfare of a state is quite as important as the dividends of shareholders. We believe these results to be practically inevitable whichever side wins, although they are perhaps more imperative for the Allies, and the Allies will probably be victorious. But, even so, their casualty lists will drive home to them the terrific price which must be paid for the luxury of stupidity. From the point of view of the women, the price is paid in husbands and sons, from the point of view of science and the arts, the price is paid in lost ideas which might have germinated in brains now dead, and from the point of view of the nation in the loss of the very flower of the race. We think proven stupidity will be at a discount.

We might go on to point out the different kinds of literature which will arise after this war—it is a fascinating topic. Even leader-writers will write differently. The muffled, grandiloquent phrase, the ability to talk a lot and say nothing, will lose much of its charm. But the function of this journal is to put the emphasis on the scientific aspect of any question. We have done this, and now we must leave it.

Rights of Joint Owners of Patents

JOINT patentees, or joint owners of a patent, no matter what the relative proportions of the interests may be, can each and all of them exercise all the rights secured under the patent entirely independent of each other and without the necessity of accounting to their co-owners. They can do everything separately and on their own account except to sue infringers, in which proceeding it is necessary that all the owners combine as parties plaintiff. In case one of the owners should decline to join in a suit to restrain infringement the suit may be instituted by the other co-owners naming as one of the defendants the one who refuses to join as a party plaintiff. Each of the co-owners may manufacture, use and sell the invention on his own account and for his sole benefit, and may freely license anyone else to do the same, and may keep for himself all the profits, and this is true even though he owns but a relatively small interest in the patent. There is no legal right in the others to demand an accounting, or any part of the profits.

Should the co-owners be bound by an agreement that neither of them will part with his interest or any part thereof, nor grant any licenses without the consent in writing of the others, he can still sell and give a good title to his purchaser and can still grant licenses to others, and the co-owners would have no cause of action against the purchaser, or licensee, but could proceed against the co-owner, who had violated his agreement for damages and possibly for a share of the proceeds. The purchaser or licensee would remain in undisturbed possession of the interest which they acquired.

Therefore, it is always best that a patent should be owned entirely by one person, or a firm, or a corporation. If two or more persons not partners in business, and not stockholders in a corporation, desire to participate in the profits arising from a patent, they should assign their interests in the patent to one or more persons in trust and by a suitable trust agreement define the powers of the trustee and specify under what conditions he may work or dispose of the patent and the interest of each of the parties in the proceeds. In this way and this way only can the interest of joint owners of patents be protected, and each of them participate in the profits, when they are not co-partners in business and not stockholders in a corporation.

Electricity

Electric Fish Discharge.—In an interesting publication which forms the 37th volume of the *Journal* of the Tokio College of Science, K. Fuji shows his researches upon the electric discharge of the isolated electric organ of the Astrape, an electric fish of the torpedo family. By the use of the oscillograph, he was able to secure a series of records of the electric discharge from the fish's organ, and he publishes curves in great number showing the character of this discharge under different conditions. The present work is a valuable contribution to this subject, and is one of the most thorough investigations that have as yet been made in this field, for the precise character of the electric discharge from these remarkable fish is here made evident.

The New York Electrical Exposition this fall will be connected by telephone with the Panama-Pacific International Exposition. There will be a demonstration room at the Grand Central Palace similar to the one at San Francisco, in which there will be 250 seats, each provided with a telephone receiver, so that the audiences at each end may listen to the conversation taking place between the halls at opposite extremes of the continent. There will be six half-hour demonstrations each day. The first one, at 2 o'clock in New York, will synchronize with the one at 11 o'clock in San Francisco, while the demonstrations beginning at 1:30 and ending at 5:30 in San Francisco will synchronize with the demonstrations in New York from 4:30 to 8:30.

New Method of Lighting Rifle Ranges.—In a recent discussion before the Illuminating Engineering Society in London, Mr. A. P. Trotter, a member of the City of London National Guard Volunteer Corps, called attention to the defects in the present systems of lighting rifle ranges. It is customary to have the men fire through a dark "tunnel" at a brightly lighted target. The objection to this system is that the target is over-lighted, producing an objectionable glare that renders the sights and the bull's eye indistinct. To overcome this objection, Mr. Trotter has devised a series of white illuminated screens which are only slightly less brighter than the target. Apertures are cut through these screens so as to reveal the target. In this way open-air target-shooting conditions are approximated. The pupil is not unduly dilated as it would be by dark surroundings, and a more distinct view of the target is obtained.

Electrolytic Iron.—A French works is now producing tubes and sheets of electrolytic iron, and this industry is likely to be a valuable one. On the patented process employed, ordinary cast iron serves as a basis, and the product consists of iron in a very pure state. The cathode rotates in a solution of ferrous salt so as to have a layer of iron deposited on the surface. Solution is kept neutral by placing iron turnings in the bottom of the tank and by adding oxide of iron as a depolarizer, which serves in part to eliminate the hydrogen deposited on the cathode. The iron thus produced is very hard at first and contains some gas, but it is then annealed so as to expel the gas and give a soft and malleable metal. Iron pipe can be made direct by using a rod as a core, and is produced in 12 foot lengths, such pipe being very strong. Sheet iron manufacture is not yet in the commercial stage, but it is expected to produce sheets of remarkably soft and pure iron without any rolling. Such metal will be valuable for stamping work and for the electric industry for dynamos and transformers.

Battery for Selenium Cells.—For experimental work with selenium cells it often happens that such cells are made in very small size with consequent high resistance. When used in circuit with an instrument such as a sensitive relay, a high voltage often needs to be applied in order to secure the needed effect. It would be quite an undertaking to mount a battery of 40 or 50 cells which would be required in such cases, but for amateur work such a battery can be made up with comparatively little trouble, provided the resistance of the circuit is very high, which means only a very small current, and again where the battery is actually put on the circuit for a short time. For such use, the cells can be made very small, which allows of a convenient makeup, and the plunge bichromate cell can here be used. A very easy method for mounting carbons and zincs can be employed. Cells are made of wide-mouth bottles about 3 inches high, using say four rows of 10 cells each, or 40 cells, placed in a flat box. Procure ¼-inch carbon rods and zinc rods (or wire), and such rods cut to the right length can be mounted by using two light wood strips, preferably cut from a wood ruler, and also a ½-inch square strip. The latter is laid on the table and the 10 carbon rods spaced along it, then the outer strip is applied and screwed down at intervals so as to hold on all the carbons by pressure. Then the zincs are all put on so as to face the carbons, in like manner. The set thus fits down into the 10 cells placed in a row. Four such sets are then joined by cross strips so that the 40 pairs of electrodes can be lowered into the cells or raised out, using suitable supports at each end of the battery. The zincs should first be well amalgamated. The usual bichromate solution, or preferably chromic acid, is employed.

Science

Investigations in Honduras.—St. Louis University has sent an expedition to British and Spanish Honduras to make a study of tropical diseases and biology.

An American Congress of Bibliography and History is to be held at Buenos Aires and Tucuman, Argentina, in July, 1916, to commemorate the first centenary of the proclamation of Argentine independence. In token of the cordial feeling entertained toward Spain, the mother country, a special invitation has been extended to the Spanish government to be represented.

Upper-air Observations at Sea formed part of the scientific programme carried out by the U. S. Coast Guard cutter "Seneca" during May and June. Twenty-eight kite flights were made, and valuable data over various parts of the Atlantic were thus obtained for the use of the Weather Bureau.

Graduate Courses in Public Health are now offered in ten American medical schools, the earliest having been established in 1909 at the University of Pennsylvania. The course is of either one or two years, and is open to persons who hold the degree of M.D., or in some cases B.S. or A.B. It leads to the degree of doctor of public health (Dr. P.H.), certified sanitarian (C.S.), master of science in public health (M.S., P.H.), master of public health (M.P.H.), or graduate in public health (G.P.H.). The University of Wisconsin gives a diploma in public health (D.P.H.).

The World's Production of Lead Pencils, according to a recent article by Mr. H. S. Sackett, of the Forest Service, probably amounts to nearly 2,000,000,000 a year, half of which are made from American-grown cedar. The United States makes about 750,000,000 a year, or more than eight pencils for each of its inhabitants. Owing to the growing scarcity of red cedar and the fact that many other trees now little used appear to be more or less valuable substitutes for that wood in pencil-making, the Forest Service has carried out a series of tests which show that, next to the two species heretofore used for this purpose, the best trees for pencils are, in order of merit, Rocky Mountain red cedar, big tree (*Sequoia*), Port Orford cedar, redwood, and alligator juniper.

The Jumping Powers of Fleas have been much exaggerated, according to a bulletin on these insects recently issued by the Department of Agriculture. The species known as the human flea (*Pulex irritans*) is probably the best jumper. According to Mitzmain, the maximum horizontal distance this species can jump is 13 inches, and the maximum vertical distance less than 8 inches. The question of the flea's jumping powers is of importance in connection with the spread of bubonic plague and other diseases of which this insect is the carrier. The Indian Plague Commission, which has investigated the habits of the Indian rat flea, finds its maximum horizontal jump to be only 5 inches, while Mitzmain records the maximum height to which it can jump as 3⅛ inches. One species of flea, the "sticktight," is nearly incapable of jumping.

Academie des Sciences Prizes.—Among the prizes which were awarded this year by the Academie des Sciences we may mention the Pierson-Perrin prize of $1,000, which was awarded to Maurice de Broglie for the *ensemble* of his work upon the ionization of gases, Brownian movement and diffraction of X-rays. The Gegner prize of $760 was awarded to Prof. G. Cesaro of Liége, president of the Royal Academy of Belgium, for his extensive researchs in the field of crystallography. Messrs. F. Jadin and A. Astruc obtained the Longchampt prize of $600 for their researches on distribution of arsenic and manganese in the vegetable kingdom as well as in ordinary potable water and in mineral waters. The $600 prize for observations upon a French colony in the field of geology, mineralogy and physical geography was obtained by M. Henry Hubert, who is connected with the West African colonial administration.

The Medical Brotherhood (*Fraternitas Medicorum*) has been formed by a committee of influential American medical men for the purpose of advancing the principles of international morality, exemplified in the work of the medical profession in warfare. This organization appears to be the outgrowth of a notable address by Dr. S. J. Meltzer, of the Rockefeller Institute, on "The Deplorable Contrast between Intranational and International Ethics and the Mission of Medical Science and Medical Men," published in *Science* of April 9th, 1915. In this address, Dr. Meltzer pointed out that while other sciences are utilized by warring nations for purposes of destruction—while art and literature and even religion are applied to partisan uses—medicine alone remains strictly neutral and works for the common good of humanity. The physician is ready to die or to be crippled for life in the service of his country, but not to aid in killing or injuring the citizens of a hostile country. All physicians are entitled to membership in the Brotherhood, and there are no fees. Applications should be addressed to The Medical Brotherhood, care of Dr. S. J. Meltzer, 13 West 121st Street, New York city.

Inventions

Stereoscopic Effects in Photographing Moving Objects.—Patent No. 1,146,293, to William A. Warman of Brooklyn, N. Y., presents a photographic apparatus in which two cameras are mounted to allow of sufficient separation to give a desired stereoscopic effect, which cameras are conveniently focused upon a common object, and suitable mechanism automatically actuates the cameras to expose sensitive surfaces to obtain a series of pictures of the common object from two points of view.

A Moving Picture Passenger Car.—A patent has issued to Antoni Truchan of Flint, Mich., No. 1,145,946, in which the primary object of the invention is to provide a passenger car, steam or electric, constructed after the manner of a moving picture theater, designed to afford amusement and instruction to the passengers traveling in the car. The car has an entrance platform at one end and an operator's platform at the other, and the seats incline downwardly toward the entrance platform, at which end the screen is located.

Novel Film for Color Photography.—Percy B. Brewster of East Orange, N. J., assignor to Brewster Film Corporation, has patented, No. 1,145,968, a photographic film adapted to be acted upon one side by light of one group of colors including from violet to green or yellow-green or even yellow, the other side being sensitive to red, orange, and yellow light. In effecting this, the film is coated on one side with an emulsion sensitized chiefly to light of one group of colors and on its other side with an emulsion sensitized chiefly for other colors.

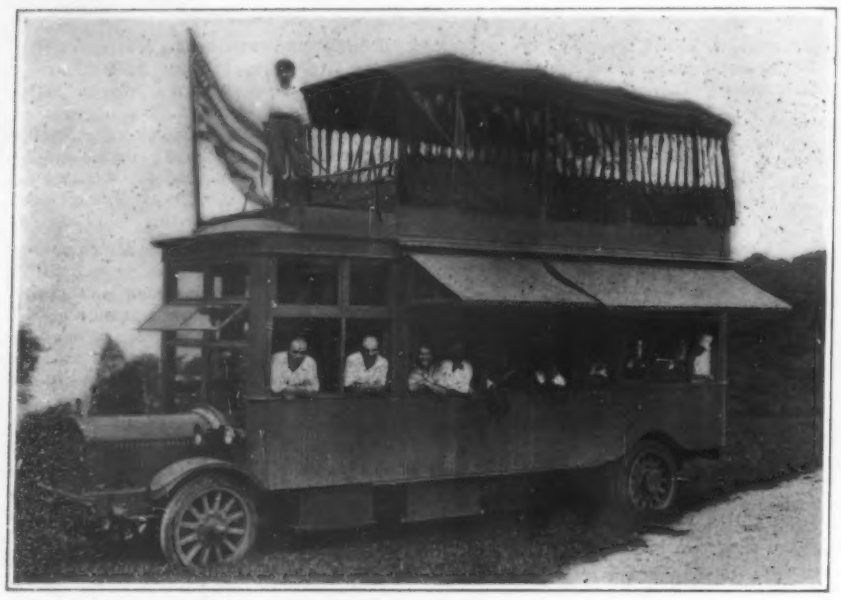
Tobacco in Cartridge Form.—Caleb C. Dula of Yonkers, N. Y., has secured three patents, Nos. 1,144,823, 1,144,824 and 1,144,825, the first and second being for tobacco packages in elongated cartridge form to provide sections for smoking or chewing, the stick or roll having a filler and a binder, and the third patent being for a pipe especially adapted for smoking prepared cartridges and formed to prevent accidental dislodgment of the cartridges when pressed into and expanded within the bowl of the pipe.

Hastening Action on Old Applications.—Commissioner Ewing has recently issued an order to the effect that after January 1st, 1916, all applications which have been pending for more than three years or which have a filing date more than three years old, shall be made special and amendments or other actions therein on behalf of the applicant which tend to put the application in condition for allowance or final rejection are to be submitted to a law examiner for his approval of its entry. This order is in pursuance of the Commissioner's constant desire to get the old applications finally settled.

Designs Upon Fabrics.—Gold and colored powders can be applied by pad and stencil process on thin fabrics so as to make attractive designs, in the following way: Silk or cotton powder is sprinkled on a table, and on it is laid the tissue, held in a frame or otherwise. A zinc stencil is laid on, then a mordant or other adhesive substance is applied, this being a paste made of rye flour, gelatine, glycerine and other substances. Stencil is raised, then the fabric is lifted off the bed of powder. Gold powder, etc., is then sifted upon the surface, and it adheres to the stencil design, producing very attractive effects, flowers or embroidery motifs; gold spangles, even of rather large size, can also be applied.

Life-saving Devices for Locomotive Cabs.—Two patents, Nos. 1,147,464 and 1,147,465, have been issued to William A. Utz of Fort Worth, Texas, for devices for saving the occupants of locomotive cabs in case of accident. In one patent there is a cushioned and asbestos-lined carrier into which a seat may descend and the lid of the carrier is connected to the seat in such manner that as the seat descends the lid will be automatically closed. In the other patent the body of the carrier is composed of a series of steel rings telescopically engaging each other and folding against a stationary top, means being provided for holding the collapsed rings against the top and for releasing them so they may descend to inclose the one to be protected.

Machinery's Influence Upon Invention.—As far back as 1876 some of the foreign commissioners to the Centennial showed their keen appreciation of the importance of invention and the advantages derived by America from its encouragement. One of the Swiss commissioners said, "I am satisfied from my knowledge that no people have made in so short a time so many useful inventions as the Americans, and, if to-day, machinery apparently does all the work, it nevertheless by no means reduces the workman to a machine. He uses a machine, it is true, but he is always thinking about some improvement to introduce into it, and often his thoughts lead to fine inventions or useful improvements." The reports to Parliament of the British commissioner state that "as regards extent of invention and ingenuity, the United States was far ahead of other nations," and that "judged by its results in benefiting the public, both by stimulating inventors and by giving a perseveringly practical turn to their labors, the American patent law must be admitted to be the most successful."



On a transcontinental tour in the motor "house-car."

A corner of the living-room and a glimpse of the kitchen.

The Motor "House-car"

BORROWING his idea from the house-boat, Mr. Roland R. Conklin, who is known in connection with the New York Omnibus Company, has built an elaborate craft mounted on an automobile omnibus chassis with which he can make land cruises. He is now on his way west, making a leisurely transcontinental tour to the exposition in San Francisco.

The machine weighs no less than 1,600 pounds. It bristles throughout with ideas and conveniences. Mechanically, it is an extra long omnibus chassis, and is conventional in structure save for the fact that the final gear reduction is through a second transmission having three speeds. The main transmission has three speeds also, so that there are nine speeds placed at the disposal of the driver. The lowest gear ratio is 86⅔ to 1, and this is expected to be low enough to enable the six-cylinder motor to pull the omnibus up any hill that may be encountered.

Outside of the nine speeds, chief interest in the car lies in the body, which is no less than phenomenally replete with every convenience. There is even a shower bath and hot and cold water supply. The lighting, heating and cooking equipments are electrical. There is a refrigerator that holds 100 pounds of ice, and provisions for two weeks can be carried, giving the car a radius of about 1,500 miles independent of supplies.

Inside, the body is 21 feet long, 7½ feet wide, and 6½ feet high. There are three compartments. On the roof are seats, water tanks, and a box carrying a motorcycle, with a davit for lowering it over the side. A large collapsible top with curtains is fitted.

Screens are fitted to all the doors and windows downstairs. The two doors, one at each end, have folding steps. In the front is the driving compartment, which has two berths stowed away in the ceiling, for the crew at night. The center compartment is for the guests, and is 10 feet long. On one side is a luxurious couch, convertible into a bed, and on the other two upholstered arm chairs, which may be folded down to form a bed. In the ceiling are four berths. When used for sleeping, each berth is curtained off and has its own electric light, just as on a Pullman.

Back of this compartment is the kitchen, with its electric range, ice box, sink, cupboards, shower bath, and a partitioned-off toilet. There is also a desk with book shelves, a Victrola and record file.

The body of the car is of wood, finished with a coat of white lead and then varnished with spar varnish. The resulting color is a brownish gray closely approximating the natural wood tint, ash being the wood that is used.

Gray Spanish linen is used for upholstery, and in order to keep it clean a vacuum cleaner is carried. There is a second vacuum cleaner for use on clothes only.

Parts of the mechanical equipment consist of a knock-down bridge with steel framework and plank flooring. With this, a 15-foot span can be covered. Provision is made for attaching a winch to the front cross member of the frame and driving it from the motor, so that the car can pull itself out of difficulties.

A Highway Chair Car

IT is difficult to find a descriptive name for the vehicle pictured in the accompanying photograph, for it combines characteristics common to the automobile, to the motor trucks, the Pullman coach and the street car. It is a motor driven vehicle designed to provide comfortable, and we might almost say, luxurious travel over the common highways, and it should prove valuable as a feeder for railway systems as well as to provide stage service between cities.

The vehicle consists of a unique body mounted on an extremely long motor truck chassis. The actual length of the one shown in the illustration is 23 feet 10¾ inches and it has a capacity of 3½ tons. A center bearing is placed at the middle of the frame and the drive from the engine to the rear wheels is taken through this center bearing by two propeller shafts. The first propeller shaft connects with the engine transmission through a universal joint, then the shaft, then another universal joint to the bearings, from the back part of the bearings and universal joint and shaft and a fourth universal joint to the rear axle.

The coach is equipped with individual chairs of a unique type. The seat is mounted on a steel spiral spring and there are four air cushions operating in conjunction to act both as a cushion and a shock absorber. This renders the seat absolutely free from jar.

The coach body is fitted with round plate glass windows, which may be opened up and hooked to the ceiling, leaving an opening 24½ inches in diameter. In the roof of the car are suction ventilators which carry off vitiated air and insure the introduction of plenty of fresh air. The car is entered by a folding door beside the driver's seat, and fare is collected on entering. The passengers leave the car through an outwardly folding double leaf door in the side, near the rear. The door operating mechanisms are both controlled by the driver. The driver is signaled to stop by means of electric push buttons placed between each pair of windows. The car is heated by means of the exhaust gas of the engine, there being twice the necessary heat units available for maintaining the proper temperature of the interior of the car in the coldest of winter days.

Robert Paul Stout

ROBERT PAUL STOUT was killed at the Redington Proving Grounds of the Bethlehem Steel Company, near Bethlehem, Pa., on August 25th, by the accidental explosion of a shell. At the time of his death, Mr. Stout had long been the engineer of ordnance of the Bethlehem Company, and was at the moment engaged in the experimental development of a shell containing a high-explosive charge and supplied with a bursting fuse of a new and improved type.

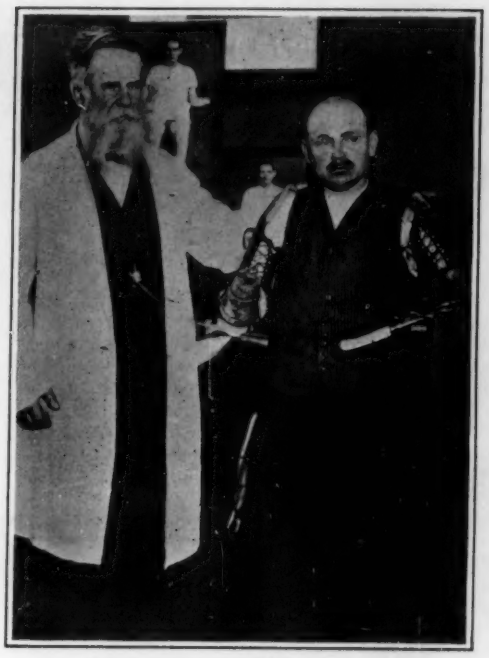
Mr. Stout was born at Bethlehem, Pa., in 1869. He graduated at Lehigh University in 1891, and entered the Bethlehem Steel Works in 1892. In 1896 he became associated with the ordnance department of the Bethlehem Company, at the time when that company, having some years before entered upon the manufacture of gun forgings, finished guns, and armor plate, first undertook to develop designs of ordnance material. This field, that of ordnance development and betterment, is a branch of engineering of much complexity, involving not a little danger, and counting, unfortunately for the national defense, but few devotees. From this date, 1896, until his untimely death at the age of only 46 years, Mr. Stout constantly applied his great talent and skill in the development and perfecting of ordnance material, and has taken rank among the most experienced and successful ordnance engineers in this and in other countries. None of the many details of ordnance material escaped his attention; and he was occupied alike in the drawing office, on the proof grounds, and in the testing and installation of finished material in place.

Mr. Stout married Miss Emma Wolle of Bethlehem and had two children, both sons, now in young manhood.

A Pullman car for highway transportation.

Interior of the car, showing the novel spring chairs.

A man fitted with four artificial limbs, working at the anvil and drill. Full of hope he soon loses the sense of being an invalid.



Prof. Hoeftmann, director of the Hindenburg House, demonstrating a man with two artificial hands and two artificial feet.

A joiner attending to his trade in spite of an artificial arm, is able to compete successfully with others in his trade.

Educating Invalid Soldiers

How War Cripples Are Taught to Do Without Hands and Feet

By Dr. Alfred Gradenwitz

IT is one of the most striking facts about this war, that a growing decline of international morals, that is, the ethics ruling the mutual relations of peoples, should proceed side by side with a wonderful strengthening of national (or "intranational") morals, the observance of such principles as make for increased internal cohesion and unity. Never, in the annals of the world, has there been such a powerful awakening of altruistic feeling, never has social solidarity asserted itself in so brilliant a fashion. It is proposed in the following to examine this revival of social conscience in a field of great interest, the care of disabled soldiers.

What was formerly the lot of soldiers who, on the battlefield, had lost their sound limbs and fitness for work? Unable to earn their living by some useful pursuit, short of organ grinding, they were mostly doomed to live on private charity or scanty pensions allowed by the State. Their life's activities were come to a premature stop, and the gloom of an idle, useless existence was all there was in store for them.

Already, after one year's duration, the gigantic conflict being waged in Europe has crippled unprecedented numbers of men, belonging to the most valuable and productive class of citizens. Are these hapless beings to spend the rest of their lives in sterile inactivity, a burden to others and themselves? Our keen social conscience shudders at the very thought of this possibility, and modern science comes to the rescue.

In fact, a suitable orthopedic treatment allows great numbers of men, who otherwise would be crippled for life, to be restored to a normal use of their limbs. All the wounded of the German army who, after the surgical treatment, are still affected with stiffness or weakness in the joints, are sent to special orthopedic establishments, in order there to be treated with massage, hot air, electricity, and gymnastics. It is wonderful to watch the rapid progress of patients undergoing this treatment. Many a man who, on leaving the hospital, was as helpless as a child, is, after a few weeks' cure (some months at the outside), as strong and elastic as formerly, and a large percentage are able to return to the front, while practically all the others can resume their professional duties.

However, there are those whom no doctor's skill can restore to their previous condition, those who also have lost some limb or other. Even these have no reason to despair, modern orthopedy teaching the art of making artificial limbs of remarkable mobility and efficacy. After undergoing a course of instruction at one of the special cripples' homes, such as the Oscar-Helene-Heim, at Zehlendorf, near Berlin, or the Hindenburg House, at Koenigsberg, those wearing such attachments will be able to take up practically any manual profession.

The first task of the instructor, in these homes, consists of making the patient independent of his friends and reawakening in him the self-confidence which he has lost. Already at the hospital, during convalescence proper, he has been induced to idle away his time with manual work of the most varied description, thus preventing him from brooding over the outlook on his future life. At the cripples' home, where he finds the military orders so familiar to him, he learns, from early morning till late at night, how to do without the help of others, and how to perform such operations as belong to our daily life. Dressing, washing, making his bed, eating and drinking, cutting his meat and bread with one hand only, all this affords an opportunity of useful exercise and is soon mastered by the patient. Left-hand writing is readily acquired by those whose right hand has been paralyzed or amputated.

The most important part of this instruction, however, begins in the workshops connected with the home, where locksmiths, joiners, shoe-makers, tailors, basket-makers, book-binders, etc., are afforded an opportunity of attending to their trades, under the unwonted conditions created by the wearing of artificial limbs. Those who, all day long, work here at the anvil or carpenter's bench, soon lose any sense of being invalids and are filled with fresh hope for the future. The ability acquired in a very short time by patients having paralyzed or amputated hands is truly astounding. What, for instance, of that man whose hands and feet have all been amputated, and who, nevertheless, as shown by our illustration, works away merrily at the anvil and the drill, or of that joiner who, in spite of an artificial arm, would not be afraid of competing with any comrade having both his hands left? Others again are employed on field or garden work, or are trained in molding, carving, etc. This practical instruction is supplemented by gymnastic exercises which not only increase the physical fitness, but at the same time exert a most beneficial effect on the patients' minds, by strengthening their hope for a prompt recovery of their health. Most teachers have themselves been disabled in life's struggle, and, therefore, had to contend against the same odds as their pupils.

Wherever possible, patients are enabled to keep up their old trade. When this cannot be done, when a change of profession proves necessary, they nevertheless remain useful members of society. Though having an iron handle, in place of their amputated hand, with which to hold their tools, they turn out as efficient work as normal workers, and many large German factories have not hesitated to employ one-armed operatives coming from the cripples' homes. What modern orthopedy and what personal energy can achieve in this respect, is strikingly shown by one of our figures, where a cyclist with two artificial hands and two artificial feet is illustrated.

The German army authorities supply free of charge to any disabled soldier such artificial limbs, supports, handles, and other means for seizing and holding the tools he may require in his work.

A man wearing artificial limbs on his arms and legs on a bicycle ride.

Invalid soldiers, with artificial limbs, working in the garden of the Hindenburg House.

Effect of the War on American Industries—II

Permanent Value to Manufacture on Our Soil with Our Native Raw Materials

By Edward Ewing Pratt, Chief, Bureau of Foreign and Domestic Commerce

THE many-sided activities of America's "scientific wizard," Thomas Alva Edison, repeatedly call for wonder and admiration. What new problems did the war present to his active, restless mind? In the manufacture, on an enormous scale, of the records for his phonograph and similar devices, great amounts of phenol, or carbolic acid, are indispensable. As already noted, this product is also the raw material for the manufacture of explosives. It is also an article of first necessity for use in hospitals. The American supply came almost entirely from Germany and Great Britain. At the outbreak of the war, both countries commandeered all available sources. The price per pound rose from 9 cents to $1.50. Edison, without loss of time, utilized two factors. He knew that in Europe it had been found profitable to make phenol synthetically from benzol, whenever its price reached 15 cents per pound. He knew, further, that tons of benzol were going to waste among the ungathered by-products of most of our great coke plants. Arrangements were at once made with two leading coke works. At his own expense the requisite benzol scrubbers were erected and an ample supply of the primary material was assured. Simultaneously, in the vicinity of the famous Edison works at Orange, N. J., a commodious factory was erected and devoted to the production of carbolic acid. By the time that it was equipped, the price of benzol in the United States began to rise rapidly. One year ago it cost from 20 to 30 cents per gallon. Now quotations have reached 90 cents. For months past the new Edison plant has manufactured daily 2,500 pounds of carbolic acid, using as basic material benzol, the cost of production of which does not probably exceed 20 cents per gallon, or 2½ cents per pound.

Soon after perfecting the mechanism for the manufacture on so notable a scale of carbolic acid by direct synthesis from American crude material, Mr. Edison turned his attention to aniline. American dyers and manufacturers of artificial colors had hitherto imported annually over 2,500,000 pounds of aniline, in the form of oil, or of its salts. Over nine tenths of the import was from Germany. The supply was cut off. The manufacture of this product from benzol is relatively simple, less difficult, if anything, than the transformation of the same liquid into phenol. A decision was quickly made. An aniline factory was soon in active operation, utilizing the ample excess of benzol contributed by the scrubbers of the coke works. The daily output is 4,000 pounds. It will soon reach 6,000 pounds. This is equivalent to nearly 2,000,000 pounds annually—not much less than the normal import. In addition, the Edison works are producing various derivatives of aniline, such as acetanilide (better known as "antifebrine," a valued febrifuge) and paraphenylene-diamine, a certain amount of which is currently required in the manufacture of phonographic accessories. The aniline currently imported into the United States in 1913-1914 cost 8 cents per pound. It is now quoted at $1.30, although contracts are made for future delivery at much lower rates.

The example is highly significant of what the sagacity, technical efficiency, and enterprise of one American citizen can accomplish in solving promptly the industrial problems due to the war. In the case before us, the manufacture of pure carbolic acid to meet the demands of our pharmacists will be continued after the war. The synthetic production of the valued antiseptic is established on a permanent basis and forms an important addition to the nation's economic plant.

Mr. Edison is uncertain as to a continuance of the manufacture of aniline after the era of high prices has passed. He has, however, furnished us a brilliant object lesson of how swiftly and easily our wasted natural resources can be mobilized in the interests of organized industry when the trained brain of an American man of science devotes a few hours to the problem.

Carbolic acid is an important "intermediate" in the manufacture of a large number of brilliant artificial colors. Aniline serves exclusively as raw material in this branch of industry. Prior to the war we imported coal-tar dyes, valued annually at nearly $10,000,000, from Europe, chiefly from Germany. Our vast textile interests, the great industries producing paper, ink, varnish, pigments, etc., were dependent upon this import for the element of color in their wares. Hundreds of other industries and occupations, using their products, were likewise, in turn, dependent upon this commercial movement. To every tailor, to every milliner, in fact to every consumer of wares involving the factor of color, it has been a matter of vital necessity that there should be no interruption in the regular arrival of the hundreds of varying hues produced on the banks of the Rhine from prosaic coal tar.

There was a limited production of these artificial dyestuffs in the United States. Unfortunately the domestic industry has depended hitherto upon German sources for its raw material, the semi-manufactured, so-called "intermediates," such as aniline, salicylic acid, etc.

The supply of intermediates ceased with the outbreak of war. The import of finished dyes from Germany was intermittent, and finally stopped totally in March of the present year. Conditions threatened to paralyze the activities of our textile interests and of allied industries. There has been a certain amount of dislocation in the mechanism of production, unavoidable under the circumstances, as the available stocks of artificial dyes, one after another, steadily disappeared from the storerooms of textile and other mills.

Thus far, the disaster has been less serious than we feared it might be four months ago. Some establishments have closed, most have been forced to material changes in designs and in processes, with more or less incidental loss. Jobbers, retailers, consumers of textiles, paper, feathers, straw work, lakes, varnish, etc., all have been obliged to adapt themselves to changed conditions. There is little doubt but that the sum total of the losses borne by American industry, as a whole, during the year 1915, in consequence of the cessation of the imports of German dyes, will far exceed in amount the capital needed to establish upon our own soil a complete, self-contained, American coal-tar dyestuff industry using exclusively American crude materials, and meeting adequately all of the nation's needs for artificial colors.

This blow in the face, as it were, has, however, acted as a tonic. Let us note the effect on our industrial organism.

The few existing dyestuff works have greatly multiplied their equipment and facilities for manufacture. They have already practically doubled the current output of a year ago. In this effort they have been forced to install the necessary plant for producing the "intermediates" formerly imported from abroad. This has meant delay, but it has been done in a thorough and permanent manner. Simultaneously, a group of new factories has sprung into existence, devoted primarily to the manufacture of "intermediates," but aiming ultimately at the production of finished dyestuffs. All of these have been hampered in their efforts in consequence of the urgent demand for coal-tar crudes by the firms engaged in making high explosives. The notable increase in the number of recovery plants attached to coke works tends to lessen the scarcity of raw material. Each week witnesses the addition of new firms engaged in solving the problem of a domestic supply of coal-tar colors, either by furnishing crudes, or intermediates, or finished dyes. Increasingly large amounts of capital are being devoted to this branch, and there is an intelligent awakening of both capital and enterprise to the opportunity offered for establishing a fairly complete coal-tar chemical industry on American soil.

Of far-reaching import is the awakening of the public conscience to the necessity of providing ample statutory protection to such an industry against unfair competition on the part of foreign rivals, especially during the incipient years. Those ready to furnish the capital, those eager to utilize scientific and technical attainments in the new branch, the thousands of immediate consumers of coloring materials, are all united in the conviction that this nation must have its own dyestuff industry. This conviction is crystallizing into a demand that unfair methods in restraint of trade no longer permissible in our domestic commerce shall be effectively forbidden by law to foreign rivals of American industries. It has been simply the dread of such methods on the part of the few gigantic foreign houses dominating the world's production of artificial colors—a dread warranted by many rude experiences in the past—which has, thus far, prevented a natural, spontaneous, healthful evolution of an American coal-tar industry, with its marvelous complex of rainbow tints, rare perfumes and powerful medicinals. It is the one great branch of production lacking to complete the cycle of the nation's industrial activity.

Side by side with the tremendous impulse given to the expansion of the manufacture of artificial colors, comes a realization by dyers of textiles that the possibilities of the natural dyestuffs have been sadly neglected during the past few decades. The facility and exactness with which coal-tar colors can be employed, the endless diversity of tints and shades readily secured by their aid, have led the modern generation of dyers to disregard, in great measure, those time-honored vegetable dyes, for centuries the only available source of color, which still give their charm and value to the choice products of Oriental looms. The present "dyestuff famine" has brought them again into prominence. Not so easily applied as the aniline dyes, they still have their special merits. As a result, the American works engaged in the preparation of extracts from the yellow oak of the Alleghanies, from the logwood of Jamaica, from the redwoods of Brazil, from the cutch of India, are providing in enormous amounts the substitutes for the more brilliant, but often more fugitive, hues of the coal-tar products.

Thus, the conditions, consequent upon the war, have been of unquestioned value to the dyestuff industry of the United States. In the future, natural dyestuffs will occupy a more important position in the textile world, and a more ample recognition will be accorded to the highly perfected processes of recent years, insuring their fastness upon the animal and vegetable fibers. At the same time we can look forward with confidence to the evolution of a genuine American coal-tar color industry.

In our country, as elsewhere, there is not only a "dyestuff situation," but also a "potash situation," following in the train of the embargo on the exportation of German wares. The world has depended largely for the supply of potash salts required in the arts on the apparently inexhaustible deposits of Stassfurt. There has been a natural monopoly, closely similar in character to that of Chile saltpeter, or Russian platinum. Over one half of the exports of German potash were purchased by the United States chiefly for use as a fertilizer, especially in the cotton and tobacco fields of the South.

For some time we have been vaguely aware that large amounts of potash compounds are present in the vast beds of kelp floating on the waves of the Pacific, close to our western littoral. During the past year these beds have been mapped by Government experts. Their character and density have been carefully investigated and the quantity of potash present determined.

It appears that each year the waters of our Pacific coast are producing a crop in which potash salts, possessing a normal value of over $90,000,000, have been withdrawn from the seawater and are readily available for use in agriculture and the arts. In a recent publication by the Bureau of Foreign and Domestic Commerce it has been shown that this crop can be harvested, dried, ground and transported to ports on the Gulf or on the Atlantic coast at a cost far beneath that paid for equivalent quantities of German potash. It is demonstrated also that this available kelp crop contains an amount of organic, nitrogenous matter equal in fertilizing value to $60,000,000 worth of Chile saltpeter. A considerable amount of phosphoric acid is also present.

Hitherto, we have imported annually potash salts to the value of over $16,000,000, chiefly for use in compounding fertilizers. It has needed the stimulus of the war and its consequent embargo to arouse industrial interest in the exploitation of this vast national asset. When the price per ton of muriate of potash—the leading commercial form—soared from $38 to $250, American enterprise realized how backward it had been in utilizing this asset.

Now a dozen companies are engaged in the campaign. Not only the inexhaustible supplies in the waters of the Pacific, but also the remarkable deposits in the arid waste about Searles Lake, in California, and the valuable alunite of Utah, are being rapidly transformed into standard, commercial grades. A year or two hence we may be able to fertilize our broad acres with American potash exclusively, while another year or two may see us free from dependence upon dyes of foreign make.

Numerous other cases might be cited, especially in the field of chemical technology; for in no other branch have we lagged so far behind while European chemists have built up a marvelously complete industry, bewildering in its perfection, in its complexity, and in its closely interlocked ramifications.

There are also certain effects of the great European war which must have serious financial and industrial consequences for the United States, particularly affecting foreign commerce. In view of this fact, the business men of this country must lay their future business courses after due consideration of the tendencies of present conditions and their probable outcome. Before

entering upon any considerable campaign to secure foreign markets, they must assure themselves of the permanency of such business.

Three questions present themselves in this connection: First, are the financial and business conditions such as to make it safe and practicable to market our products abroad? Second, can we hope, as a debtor nation, to finance foreign trade on a large scale? Third, will the cost of production in the warring countries of Europe be lowered as the result of the war, so that after its close we shall be unable to hold the new markets that we may have gained?

Those who believe that conditions are so bad in foreign countries as to make it impracticable for our manufacturers to market their products abroad, point to the South American countries, which they say are almost bankrupt, that the war has ruined their trade, that they have no money and no credit, and cannot, therefore, buy our goods.

The Latin-American countries are all producers of raw materials. Their products formerly found markets in the United States and Europe. At the outbreak of the war the European markets suddenly almost ceased to exist, and the countries of Latin-America were nearly paralyzed commercially, industrially, and financially. Since the first shock, however, partial readjustments have taken place, and there are indications of a general revival. These countries are now looking to the United States to supply a market for their surplus products, to secure the credit for making new purchases, and to advance the loans which are to replace the European capital which has been withdrawn. The present time, therefore, is opportune for business men of the United States to study the Latin-American markets, to learn these countries, to get in touch with the people, and thus to open the way for extensive business operations. In other countries also the present offers unprecedented opportunities for the extension of our foreign trade.

While the United States is a debtor nation, we are rapidly discharging our foreign obligations. During the fiscal year ending June 30th, 1914, the net balance of trade (merchandise, gold and silver and remittances) against the United States may be estimated at about $55,000,000. During the following year the balance was about $650,000,000 in our favor. This balance, which promises to continue in our favor for some years to come, will serve to pay off our indebtedness abroad. Indications that we are entering upon a creditor period are the tremendous shipments of gold to this country, the low sterling exchange in New York, and the large foreign loans which have been placed in the United States during the past year. We are, therefore, in a position as we have never been before, to invest our capital in industries and developments in foreign countries.

With regard to the cost of production in the warring countries, experience has shown that it is apt to be higher, instead of lower, after the close of the war.

It is reasonable to suppose that after the great European war there will be tremendous demands for liquid capital to rebuild the devastated areas and to overhaul the plants that have lain idle, that interest rates will rise, that taxation will be very much higher than before the war, that the diminution, through death and permanent injury, of the efficient labor supply will advance wages, and that, in consequence, the cost of production and the prices of commodities will be materially higher in the countries which are now at war. Statistics show that past great wars were followed by periods of higher interest rates, higher wages, and higher prices in the warring countries.

It is evident, therefore, that the European war has brought about conditions which warrant the business men of this country in materially extending their foreign trade, and that, with the exercise of common sense business methods, the new foreign markets gained can be held after the cessation of hostilities in Europe.

Surveying the entire field, it may be justly said that the world's conflict has been of unmeasured value to American industry as a whole. It has forced us to create new branches and it has stimulated us to enlarge the scope of existing phases of manufacture. Above all, it has opened the way to utilize, on a vast scale, great natural resources of our land, and has induced our manufacturers and merchants to expand their markets into foreign fields, thus providing work for thousands of eager hands and fortifying immeasurably our position as an independent, self-contained, economic entity among the nations of the world.

The Telephone in Latin America

ACCORDING to statistics published by the Pan-American Union, there were on January 1st, 1914, 232,816 telephones in Latin America, as compared with 9,542,000 in the United States. Argentina stood first among the Latin American countries, with 74,296, but Uruguay led in the proportion of telephones to population, with 1.05 per 100.

Correspondence

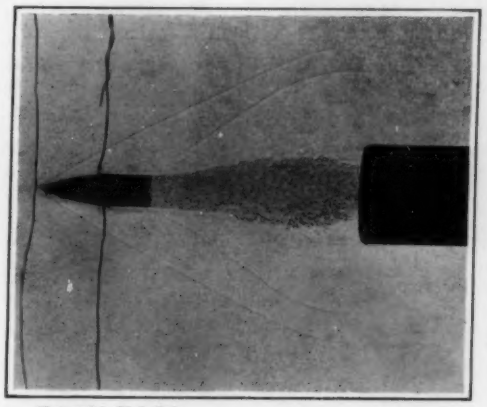
[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

The Whiplash Crack and Bullet Sound Waves

To the Editor of the SCIENTIFIC AMERICAN:

I have followed with interest the frequent articles in your columns on "What Makes the Whiplash Crack?" I am not sure that I have seen any article which is conclusive. I have possibly given this one subject as much investigation as anyone else and it may be that my comments might help in further study of this interesting problem.

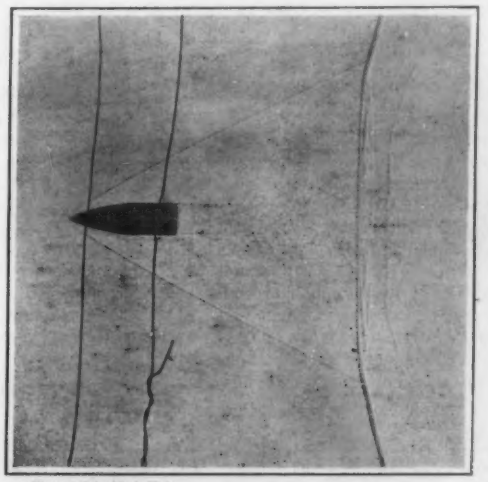
When I first began shooting firearms with Maxim silencers, I noticed that I had a peculiar sharp "crack" noise when I used certain cartridges, regardless of the size of the silencer used. I remember on one occasion experimenting with the Springfield rifle, in which is used the high velocity 0.30 caliber pointed bullet. I



Photograph by W. A. Hyde

Wake of a bullet emerging from a silencer.

This photograph was made at the muzzle of a Springfield caliber 0.30 U. S. service rifle fitted with a Maxim silencer and firing U. S. service cartridge. The bullet had a velocity of approximately 2,700 feet per second. The "bow wave" is distinctly seen, as is also a peculiar "stern wave," which follows in all bullet photographs thus far made. This "bow wave" is the "crack" noise which is given off from every object traveling through the air at a velocity in excess of the velocity of sound. It is to be noticed that there is no other noise wave in this photograph.



Photograph by W. A. Hyde

Air wave in the wake of a bullet.

This photograph was made just beyond the muzzle of the Springfield caliber 0.30 U. S. service rifle without silencer, and firing U. S. service cartridge. The bullet has the same velocity as in the other photograph. The "bow wave" is again distinctly shown, but a very much stronger wave is also shown following behind the bullet. This heavy wave, shown by the nearly vertical curved line, is the report noise of the unsilenced rifle. Back of this main report wave are seen minor waves whose cause is not definitely understood as yet. The main report wave is advancing at the velocity of sound approximately 1,085 feet per second, whereas the bullet is advancing at a velocity of 2,700 feet per second. This accounts for the bullet's having gained upon the report wave.

was assisted by an army officer in these experiments and our attention became especially directed to this peculiar "crack." I made silencers all the way from 1⅜-inch diameter and 6 inches long up to 2-inch diameter and 3 feet long. The largest silencer was a final heroic effort to control all noises by providing an enormous capacity. Of course, such a silencer would be utterly impractical, but it served to dispose forever of the doubt as to the silencer's being big enough to take care of all the noise.

This mammoth silencer left the same crack that the normal silencer left. I then suspected that the noise was not made by the gun. My suspicions had been gradually crystallizing by the different "cracks" which my trained ear had noticed when firing in different localities. In order to settle this, I found a building in which I could have my assistant stand while shooting. There was a broken glass in the window and we decided to close every window and shoot through this hole in the glass at a tree several hundred yards distant. I stationed myself outside. He had the big silencer on the Springfield inside the building. It was conclusive that no gun noise could reach me at my station two hundred yards away from the building.

When the gun was fired, I heard the troublesome "crack" just as plainly as when the gun was located out in the open. It sounded exactly like the crack of a whiplash and seemed to be over my head. Furthermore, I distinctly heard two cracks succeeding the main crack. Oddly enough, there were two separate clumps of bushes or small trees beside the line of flight of the bullet before it reached the distant tree. I surmised at once that each of these clumps caused the secondary cracks I had heard.

I then became possessed with a desire to fire down a long straight railroad track beside which there would be, at regular intervals, telegraph poles. These poles would offer reflecting objects just as the clumps of bushes. We searched around and found a spot where we could safely shoot down a railroad track. It turned out precisely as I suspected. There was a separate and distinct "crack" for every telegraph pole. No matter where I stood along the line of bullet flight, I heard the repeated cracks. They were exactly like a series of whiplash cracks.

This settled in my mind that the noise was caused by the bullet. Then I wanted to know why some cartridges would give the "crack" and why others would not. I began shooting different cartridges. Everything "cracked" from 0.30 caliber up to 0.45. Below 0.30 caliber, the "crack" vanished with the 0.22 caliber long rifle cartridge. The 0.25-0.20 cartridge "cracked" good and plenty. In fact, there seemed to be no difference between it and the powerful 0.405 caliber Winchester elephant cartridge. But when I got down to the 0.22 calibers the "crack" disappeared.

I began feeling my way among the different 0.22 calibers. As I have said, the 0.22 long rifle smokeless or black powder did not "crack." The 0.22 caliber Lesmok long rifle did "crack." The 0.22 Winchester automatic did not "crack." The 0.22 long, both smokeless and black, did "crack." About half the cartridges in a box of 0.22 caliber W. R. F. Winchester make would "crack," whereas all of the cartridges in a box of 0.22 W. R. F. U. M. C. make would "crack." The 0.22 short, smokeless or black, would not "crack," whereas in some cases the 0.22 Lesmok would "crack" lustily.

Immediately I suspected that velocity had something to do with it. I wanted to make sure, so I made bullets by hand of various designs. Some had holes all the way through the center to break up the suspected vacuum at the base of the bullet. A gas check sealed the hole while the bullet was in the barrel, but fell off after the bullet left the barrel. I made bullets shaped like a cigar, or of streamline design. None of them altered the "crack" in the slightest degree. I was forced to conclude that this whiplash "crack" was purely a matter of velocity.

I then began measuring velocities while listening for "cracks." I found that there was a critical velocity above which any kind of a bullet would always "crack," but below which no kind of a bullet could be induced to "crack." Then the curious thing developed. This critical velocity coincided with the velocity of sound. When the conditions were such that the velocity of sound was 1,085 feet per second, a bullet traveling at 1,084 feet per second was practically silent, whereas a bullet traveling 1,085 feet per second made a "crack." It made no difference whether the velocity exceeded the critical by one foot per second or 2,000 feet per second, except that with the latter velocity the bullet continued to give off cracks for a longer time. In other words, until its velocity fell below 1,085 feet per second.

This was followed by photographs of the bullet, and these photographs distinctly showed the sound wave. I am showing some of the best photographs I have and in the title will be found the description of the air wave.

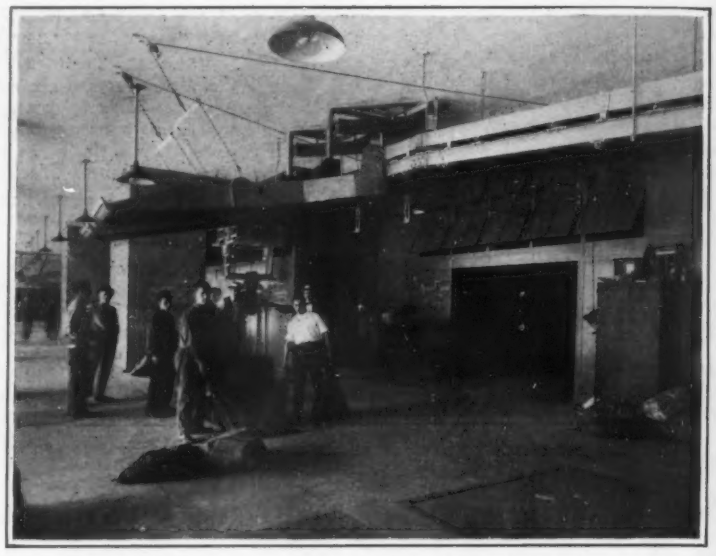
We now come to the whiplash, about which all this anecdote revolves. The reason the whiplash cracks is because the snap causes the tip of the lash to exceed the velocity of sound. The air is then disturbed to a degree which sets up the wave. This wave causes the "crack" sound.

While all this pretty conclusively explains the phenomenon of the crack of the whiplash, it also shows the limitations of strictly noiseless shooting. We can never hope to acquire strictly noiseless shooting if the bullet velocity exceeds 1,085 feet per second. In fact, we know that all shooting to be silent must be below this velocity.

HIRAM PERCY MAXIM.

Hartford, Conn.

Conveying mechanism for assembling sacks carrying packages of the parcels post. Note the switch by which the pouches are diverted from the conveyor.



The loading platform, showing mail sacks from the wagons being sent down through chutes to the mail trains.

Mechanical Equipment of the Grand Central Post Office

It Meets the Necessary Requirements for Increased Speed and Economy

By Herbert T. Wade

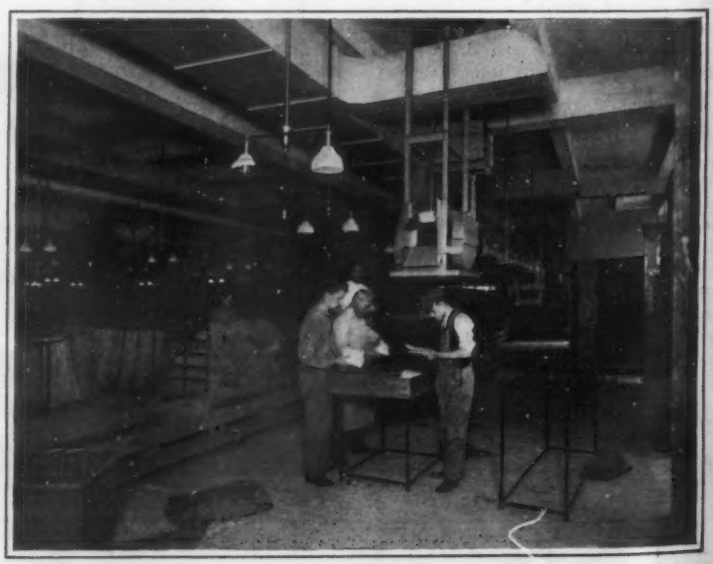
WITH the increase in the volume of mail handled at the post offices of the great cities of the United States it has been necessary to provide special arrangements at the large railway terminals to facilitate the handling of the mail bags, and the work has been further complicated by the increased amount due to the parcels post. In planning the great railway terminals which are now such features of the large cities of the United States, railway authorities have co-operated with post office officials in providing means for the rapid dispatch of the mails, and a committee of the latter in turn has studied the necessary requirements for increased speed and economy. At many of the larger terminals pneumatic tubes convey mail from the sub-stations in various parts of the city to the point of dispatch, while the mail already made up and packed in pouches, and especially the bulkier mail, such as newspapers and magazines, and the various packages making up the parcels post, are now brought to these points on motor wagons. Within the mail terminal itself many interesting and elaborate mechanical appliances are being installed so that a minimum of handling is required, saving the services of porters and hand-trucks, and these innovations represent the best and most modern practice in mechanical engineering.

The most recent and important installation of this kind recently has been opened in the city of New York at the Grand Central Terminal, where the mail of the greater city, and that received from Europe and the South, that goes to New England or through New York State and to the west, over the lines of the New York Central & Hudson River Railroad, is loaded directly on the cars. Ever since the new Grand Central Terminal was put in working order a post office station has been maintained here, and the volume of business handled at this point has grown enormously, so that it now amounts to some 800,000 pounds per day. This terminal station was installed in the eastern wing of the terminal facing on Lexington Avenue, in a building in part occupied by the executive offices of the New York Central & Hudson River Railroad, but as extra space was required a new building to the north between Forty-fifth and Forty-sixth streets, facing on Lexington Avenue on the east and Depew Place on the west, and on the opposite side of the street was built, especially designed for the rapid handling of the mail delivered there by motor trucks or by pneumatic tubes at the adjoining local station. This new building at present is three stories in height, with some 100,000 square feet available floor space, but the railway which built it and leased it to the Post Office Department filed plans for a twenty-story building, so that it can be extended later. It is interesting to note as an indication of new developments that the Treasury Department, through its supervising architect, has decided that hereafter in certain western cities post office and other Government buildings must rise to the heights demanded by good commercial economy rather than occupy costly ground space merely because they are used for official purposes. The new post office building is built directly over the tracks of the terminal, at which point are special sidings for express and mail cars, connected by switches with the main network of tracks, so that the mail cars can be filled directly from chutes and then made up into through trains without delay.

This new post office is designed primarily for the outgoing mail and the parcels post, the incoming letter mail being handled at the old adjoining post office station and distributed by tubes and motor wagons very much as formerly. The local post office is, however, connected with the new building by belt conveyors and communicates directly below with the tracks.

The general operation of the new plant and its mechanical conveniences may be appreciated by the following outline description. On its western front, for the entire length of the building, there is a loading platform shown in the illustrations where the motor trucks carrying the mails from the main or sub-post offices or other railway terminals can unload directly. In case the mail has been distributed at the main post office or elsewhere and is in the appropriate pouches or sacks ready to be loaded directly in the mail cars, the sacks are thrown into chutes in the floor which extend directly to the loading platform on the basement or track level where the mail cars are placed on side tracks. These sacks fall on the platforms or may be conveyed directly to the doors of the cars and, of course, may be stowed aboard immediately. If the mail requires to be made up the bags are thrown into other chutes which connect beneath with a conveyor belt running the length of the building and communicating in turn with transverse belts that extend through the building, to which the sacks are transferred and thus are passed to the various departments, where the mail is sorted and made up according to its destination. These belt conveyors have junction points or switches where mail for a certain section of the country may be deflected under the control of an operator at the switch board, the sacks being delivered

Belt conveyor carrying mail from outside platform to be sorted before being sent down the chute to the trains.



Conveyor dropping letter mail to sorting table to be distributed, pouched, and dispatched by a lower conveyor to the loading platforms.

automatically at a special table or platform. Thus, the bags for the northwest pass to one section of the floor and those for New York State to another. The larger and northern section of the main floor of the building is devoted to parcels post packages, but some space is given over to letter mail, while on the floor above the second-class mail is handled. The belt conveyors are of considerable length and are operated by electric motors. They are broad belts on which the bags are readily carried to and from any desired part of the floor. In addition to being arranged to take the mail from the platform the conveyors can also handle incoming sacks, discharging them directly to the wagons in case they are to be transferred across the city to other terminals or sent to the separate local post stations.

Looking below on the loading platform at the track level between two tracks there are to be seen two belt conveyors, one 940 feet long, extending along a 1,700-foot platform, and the other on the opposite side 600 feet long, and these carry the sacks to the car desired, the longer belt serving about 9 cars, delivery chutes being located at intervals of a car length.

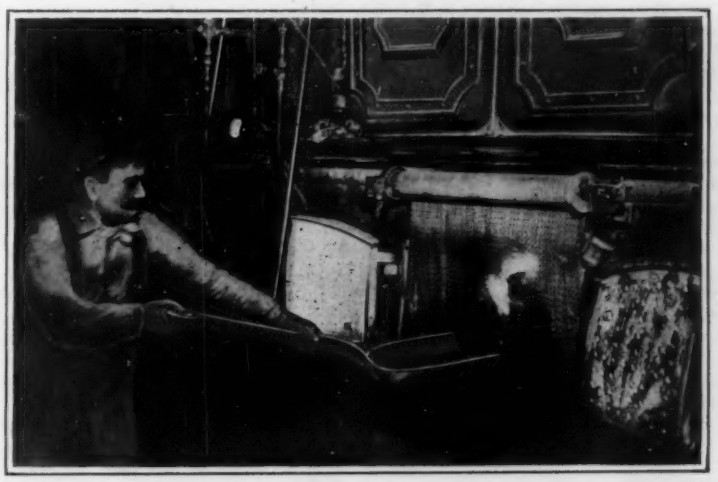
In addition the building has a system of electric elevators large enough to carry hand or motor trucks loaded with mail bags, which can be wheeled on the elevator platforms and carried up or down as desired and over to such mail cars as are not put on the sidings, but are placed with local trains. There are also spiral chutes for carrying the bags down and bucket lifts on which the bags may be carried above from the loading floor. In this way mail is loaded on some 227 trains, eleven of which are mail trains exclusively. There are no pneumatic tubes used only for letter mails from the outside, but terminating in the adjoining local station there is a complete tube system whereby incoming mail may be distributed to the main post office and to the various sub-stations as far as made up. On the other hand letters may be sent up through the tubes and made up for the trains. The general arrangements permit of receiving letter mail up to ten minutes before the leaving of the train, and newspapers up to fifteen minutes before train time, as these now can be handled at the terminal entirely by machinery or by motor trucks without loss of time. The cars for the fast mail trains stand on the sidings below, near the express tracks, so that making up a through mail train is a very simple matter.

The entire building is connected by telephone with a single operating station on the main floor and with the entire railway mail distribution system of the city centered at the Pennsylvania Terminal, and at the downtown post office, and at other terminals. The volume of business is so large that some 10,000 sacks of parcels post matter are handled per day, and this naturally involves considerable weight compared with the letter and newspaper mail of former times. The new building on its second floor is equipped for distributing and making up the mail, the clerks working in front of large pigeon holes where the mail for different sections of the country is distributed preliminary to being collected. The new station with its mechanical arrangements must be considered as a fundamental link in the railway mail service rather than as a local distributing point, as the mail from the South and the foreign mails for distribution in New England and the west as supplied by the New York Central system pass through this office.

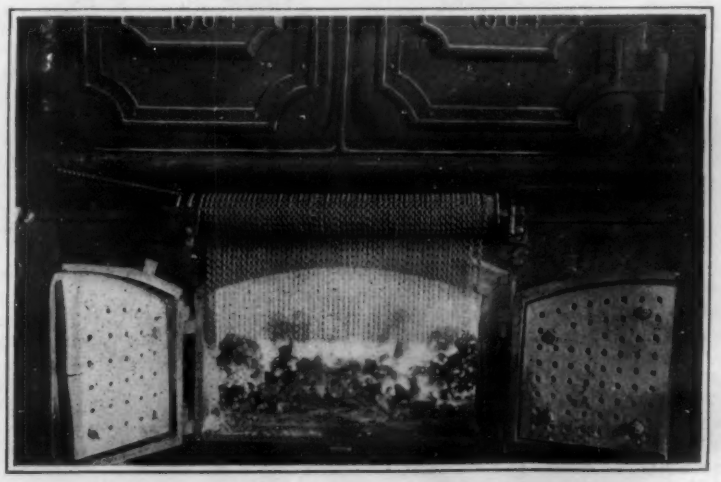
It must not be inferred that the equipment is the only consideration, for there is involved a well-trained *personnel* where each man realizes the part he is to play and just where each bag is to be sent and the proper route to be followed either by chute, conveyor or truck. Careful superintendents with watches in hand mindful of train schedules keep a keen eye on the sacks and speed their destination, while standing before a network of open sacks or pigeon holes, parcels, papers and letters are sorted out to the appropriate destinations. With mechanical equipment there is combined the efficiency of the individual and the percentage of error occurring in the United States railway mail service is infinitesimal. It must be remembered that from the time it is mailed until delivered the route of travel of a letter is governed at every stage by human intelligence even when that intelligence is aided by such elaborate mechanical equipment as is to be found at the Grand Central Terminal.

Tearing down the wall through a chain shield in a glass factory, preparatory to replacing the pot.

Recovering the pot from glass furnace through a chain screen shield which is easily parted.



Throwing coal through a chain screen door. The work is done with comfort within a few inches of the strands.



Chain screen on a boiler furnace falling down to close the opening. The curtain of strands looks like a coat of mail.

Chain Screen Doors for Oven and Furnace Openings

EVERYONE who has had to work around ovens and furnaces knows what discomfort has to be endured by the attendants because of the heat and gases coming out through the uncovered opening, when the doors are thrown open, and, further, what a chilling effect the inrushing cold air has upon the interior and the contents. Doors, however, must be opened; be it to renew the charge, manipulate the contents, or study the interior conditions.

What is needed is a door which will permit a clear unhampered view of the interior of the furnace or oven; that will not in any way interfere with the free manipulation of the tools required to care for the interior, and that will keep the heat within and the cold air out. In other words, a door is required which shall possess at the same time the qualities of transparency, penetrability and opaqueness. This seeming impossibility has been realized in a door of chains such as shown in the accompanying engravings.

The chain door, in the form used mostly around glass, metal and chemical furnaces, consists of a multitude of freely hanging individual strands of steel chain suspended, close together, from a steel bar in a manner to form a continuous sheet or curtain of chain, not unlike the familiar Japanese screen.

The chain curtain, looking like a coat of mail, is hung before the uncovered opening of a furnace and effectively hinders the heat, glare and gases from leaving the furnace, and the cold air from entering. The curtain is easily parted and the strands pushed aside by the tools or other objects projected into the furnace, only to fall together again when entrance has been effected. The holes in the links of chain permit an unhampered view of the interior. In fact, a better survey may be obtained than under ordinary conditions, as the glare is toned down and the effect is similar to looking into the furnace through a piece of wire gauze.

In some plants, when it is necessary to work in front of the uncovered oven or furnace, the workmen are obliged to stand back a great distance from their work and to protect their bodies from the heat and glare with large sheet iron shields which are supported by one hand, while the other manipulates the tools. This seriously handicaps the workman and cuts his efficiency in half. In plants where the new chain screens have been employed the workman has both hands available for his work and may, with comfort, freely manipulate his tools, while standing within a few inches of his work.

When it is necessary to remove a damaged pot in a glass works the chain screen shield is hung in front of the wall inclosing the pot that is to be removed. The wall is then torn down and the hot blocks composing the same are dragged through the chain shield and put aside. The broken pot is clearly seen in the furnace behind the screen, and the workmen may operate without discomfort close to the pot itself, so that they can pry up the pot, shove the nose of the pot-trucks under the pot and drag it through the shield out of the furnace, the strands of chain immediately falling together again, keep the heat in and the cold drafts out of the oven or furnace.

When the truck carrying the new pot

(Concluded on page 238.)

Strategic Moves of the War—September 1st, 1915

By Capt. Matthew E. Hanna, Recently of the General Staff, U. S. A.

FOR another week the Teutons' offensive in Russia has carried everything before it, and the versatility of their efforts to gain a decisive victory over the forces of Grand Duke Nicholas continues to hold the interest of the world. However great their successes up to date may appear when viewed superficially, the fact remains that the supreme victory for which they are striving is yet to be won, and there is much discouragement for them in their lack of decisive success. But, whether their discouragement be great or whether it be small, they are always ready to begin a new effort none the less determined than the one which preceded it. Whatever we may say about their failure to secure the great prize for which they are struggling—the overthrow of the Russian army—we must admit that if the week be considered as one round in the great fight, it has been won by them on counts.

The campaigns in the western and southern theaters are at a standstill. The Allies in France and the Italians in Italy have made occasional spurts which have accomplished nothing of importance that has not been almost immediately offset by a counter offensive of the Teutons. The Allies in the Dardanelles seem to be losing none of their determination to reach Constantinople, and apparently have succeeded in enlisting the aid of Italy, who recently declared war on Turkey and immediately followed the declaration by dispatching an expedition for Gallipoli, presumably to be landed somewhere on the shores of the Gulf of Saros. Still the Turk holds out, despite shortage of ammunition, which, by the way, may not be so serious as reports indicate.

In Russia the Teuton harvest of local successes all along the extended line from the Gulf of Riga to Rumania has been as bountiful as at any time since this campaign began; so bountiful, indeed, that an anxious world of onlookers are wondering whether they are witnessing the beginning of the end of the Russian army. Brest-Litovsk, the citadel of the much-talked-of second line of Russian defense, has fallen, and, as a consequence, the entire line has become untenable. Kovel, the important railroad junction on the edge of the Pripet marshes, has been captured, opening the way for further successes for the Teuton armies in this region. Grodno, the one point of the Russians' second line that is still in their possession, is nearly surrounded, and we may hear of its fall at any moment. The German armies in the region of the Gulf of Riga continue to push on toward Dvinsk and Vilna, and the Austrians in the extreme south are forcing the Russians back from the Dniester.

For four weeks the German forward movement has gone impetuously on, and one event of prime importance has followed swiftly on the heels of another. This is the first day of September; on August 1st the Teuton batteries had only begun to fire their shells into Warsaw, and the great Polish salient was still in Russian hands. In the first week of August, Warsaw, Ivangorod and Serock fell one after the other on successive days. During the second week Lomza and Ostrolenka were added to the Teuton list of captured fortresses. Three more great defenses, Kovno, Novo-Georgievsk and Bielsk, fell during the third week, and finally, in the week just terminated, Ossowetz, Kovel, and Brest-Litovsk have fallen before Teuton guns and assaults. No wonder we ask what the next week may add to the lengthening list of victories that mark the superiority of Teuton foresight, organization and training over Russian unpreparedness—the superiority of the smaller "nation in arms" over the greater nation with its military strength imperfectly developed. Once more we see the unwisdom and consequences of confusing military resources with military strength.

Time and again during this campaign the Teutons have attempted to group their forces so as to administer a crushing defeat to the entire Russian army. First came the drive through Galicia in May, which was stopped when the Russians reached the line of the Dniester and Bug rivers. Then came the concentric advance from north, west and south on the great Polish salient, but the Russian commander at Grodno, Ossowetz and Bialystok on the north, and at Lublin, Cheim and Kovel on the south, held back the jaws of the pincers until he had extricated the bulk of his army from the narrowing circle. Meanwhile the German force in the region of the Gulf of Riga has been steadily strengthened and has advanced nearer and nearer to Dvinsk and Vilna, but from somewhere the Russians have found the forces with which to check its bold attempt to swing around the northern wing of their army and cut it off from the Baltic coast. It is too early to say that this attempt of the Teutons has failed, or that it may not succeed when further defeats of the Russians in other regions and increased activity of the Teutons elsewhere on the long line may greatly reduce the defensive power of the right wing of the Russian line.

And now the Teutons have begun a new offensive, on the southern portion of the battle front, where comparative quiet has prevailed for many weeks. Not until the history of the war is written will we know the full and correct details of all the complicated and vast shifting of troops that has taken place behind the lines during this campaign, without which knowledge anything like a correct statement of the strategic moves of the campaign manifestly is impossible. We may be fairly certain, however, that the Russian forces in the south have been greatly weakened during the past weeks by withdrawals to meet the tremendous blows that have been struck at the Polish salient and farther north. Likewise, the Teutons doubtless have stripped their southern battle front to the barest necessities to secure the forces needed for the knock-out blow they hoped to deliver farther north. The shortening of their lines by the capture of the Polish salient, together with the lessened resistance of the Russians and the impracticability of using great masses of men in the extensive forests and marshes east of Brest-Litovsk has made it possible for them to re-enforce the southern portion of their line sufficiently to renew the offensive.

The Russian battle line on September 1st.

The success that has accompanied this new advance in the last days of the week under consideration indicates that the Russians have been surprised; and herein lies one of the greatest advantages of the offensive as compared to the defensive. The offensive has the lead and the defensive must play to this lead. The Russian commander cannot know what is going on behind the Teuton line, and he must be prepared to meet a blow wherever it may fall. On a battle front as long as this one in Russia, the Teutons have a splendid opportunity to concentrate large forces by rail in a short period of time and attack the Russians before they have discovered that the movement is in progress. Such an attack is quite sure to be successful for a time, that is until the Russians succeed in concentrating a force sufficient to check it.

From east of Kovel to the extreme southern wing of the battle front on the Dniester River the Russians are being driven back. The Teuton attack is being pushed the hardest along the southern edge of the Pripet marshes, evidently with the intention of separating the southern wing of the Russian army from the portion farther north. The Russians are falling back on the fortresses of Lusk, Rovno and Dubno, and these may give them the support which will enable them to hold out until re-enforcements from points farther north can come to the rescue. The character of the country favors this effort of the Teutons to pierce the Russian line, for the Pripet marshes protect the left flank of their forces in the south, and make a Russian counter offensive very difficult. Once the Russians have left this impracticable marsh country behind them they can reunite their lines to the eastward, but before they again reach the open country we may expect the Teuton to make a supreme effort to break their line and drive the southern wing toward the Black Sea.

The southern movement may have a decisive bearing on the campaign to the north, if it forces the Russians to withdraw strong forces from the regions of Dvinsk and Vilna. Grodno appears to be about to fall, and if it should the Teutons can then hold the western margin of the wooded and marshy region on the hundred and fifty-mile front to Kovel with comparatively small forces, thus releasing strong forces for the drives they may make north and south of this region. We are compelled to admit that their chances are good for success on one or both wings, but the phenomenal skill of the Russian commander may again save his army from destruction.

During the first months of this campaign when the Russians were abandoning Galicia, and even during the period when they were surrendering Poland to the invader, their movement is correctly termed a *withdrawal*, growing less orderly and systematic possibly as the weeks passed and they felt more and more the shortage of ammunition and the defeats they suffered. The abandonment of their second line of defense on the Bug, and particularly the precipitate retreat from Brest-Litovsk, the most strongly fortified area of Eastern Russia, seem to mark the period in the rearward movement when the withdrawal changed to a *retreat*, characterized by an abrupt breaking down of the resisting power of the Russians. Later events may show this surmise to be incorrect, but if they should not we may see before snow flies the first symptoms of a weakening of the bonds of organization and discipline that mark the beginning of a rout, the prelude to ruin.

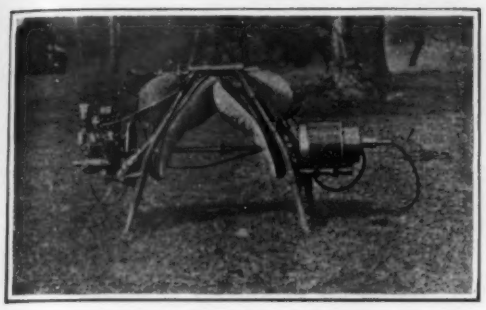
Retreat, rout and ruin—these are the successive steps in any great decisive victory. The fruit of victory is gathered in the pursuit that follows. A victory without an energetic pursuit that fairly demoralizes the defeated army may be comparatively barren of results. These are fundamental principles of German strategy. In the olden days great battles were fought to a decision and the routed army pursued to the last breath of man and beast and the whole operation covered a brief period of but a few days. Lee was defeated at Gettysburg in three days and another three days pursuit ended with his army south of the Potomac. But in this Russian campaign we are witnessing a new kind of warfare, in which the forces are so enormous and the area over which they are fighting so vast that after four months we have but reached the phase that may properly be styled the retreat. Again we see illustrated the great resisting power of the army of millions fighting on a front measured in hundreds of miles, and in this lies the possibility that the Russians may hold the Teuton at bay until relief comes with winter or some diversion in other theaters of the war.

Colloidal Gold for Infected Wounds

INJECTIONS of colloidal gold are being used in France with great success in the treatment of the infected wounds which have been so plentiful in the present war. According to a recent number of the *Revue Scientifique*, MM. Cunéo and Rolland have thus treated a series of wounds in which the phenomena of infection persisted after surgical treatment.

The gold was administered by the intravenous method (2 or 3 cubic centimeters) by intramuscular puncture (up to 50 cubic centimeters), or even by injections in the peripheral zone of the infected region. The gold is said to give the best results in large traumatisms of the limbs, with infection by anaerobic species (septic vibrions and especially *perfringens*). The effects of the treatment are less satisfactory in cases of pyogenic infection. In cases of wounds penetrating the abdomen, the authors have successfully employed colloidal gold as a preventive of infection.

Intravenous injection is formally indicated when it is desirable to obtain quick action and when the subject is in a state of hypertension. On the contrary, when the subject is depressed and in a state of hypotension, the intramuscular method is preferable.



Pack saddle wireless power plant.

Pack Saddle Wireless Telegraph Station

A VERY interesting mobile wireless telegraph equipment is being used by the British army. Four horses carry the equipment. On one is packed the power plant, another carries the receiving apparatus, a third horse bears the transmitting apparatus, while the mast and accessories are loaded upon the fourth horse. The power plant is particularly interesting. This is illustrated in the accompanying engraving. The design of the saddle is such as to form a support for the plant. On one side is mounted a generator and on the other a small gasoline engine. After the saddle has been lifted off the horse and placed on the ground, the engine and the generator are connected by a shaft. It takes but a moment to prepare the plant for work.

Rendering War Vessels Invisible

OWING to the enormous range and accuracy of modern naval guns it is highly important for small war craft which depend upon speed rather than armor plate to weather the attacks of the enemy, to render themselves invisible as possible. Heretofore, a dark gray paint has been considered the best color to supply to a war vessel. Now experiments are being made with varieties of colors. Ideas are being borrowed from the mimicry of nature. We find certain animals cloaked with spotted fur and others with stripes, depending upon the nature of their environment, and these colorings make them very difficult to discover in their natural habitat. In exactly the same way our naval authorities are trying to render torpedo boats invisible by painting wavy stripes on them, which at great distances can hardly be distinguished from the natural wave formations of the ocean's surface. The accompanying photograph illustrates the United States torpedo boat "Tripp" equipped with such a "cloak of invisibility."

Curious Italian Ambulance

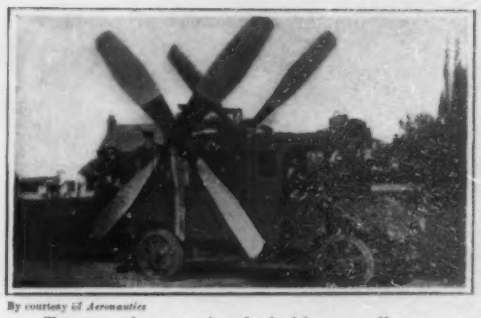
THERE is a vast difference between real warfare and dress parade. Under the exigencies of a difficult campaign one must put up with makeshifts improvised from the readiest means at hand. An illustration in point is to be found in the accompanying photograph of a curious ambulance used by the Italians in the fighting in the Alps. This is really a large sled, fitted with two small wheels. The sled runners permit of hauling this ambulance over the snow while the road wheels permit of running over bare stretches of ground. The sure-footed little donkey is the best means of locomotion for this type of vehicle. An ambulance of ordinary proportions could not be used on many of the narrow roads and pathways of the Italian Alps.

Winding Stairway of Reinforced Concrete

THE accompanying photograph illustrates a difficult piece of reinforced concrete work. It is a winding stairway forty feet high, and has fifty stairs which make two complete turns around the shaft. The center shaft is four feet six inches in diameter and was made all in one piece of solid concrete. The ornament at the top of the shaft was also made of concrete. The stairway extends from the $150,000 viaduct bridge which was just completed and spans the Hudson from Glens Falls, to South Glens Falls, New York. The winding stairway leads the way to the famous "Cooper's Cave," which is spoken of in the "Last of the Mohicans."

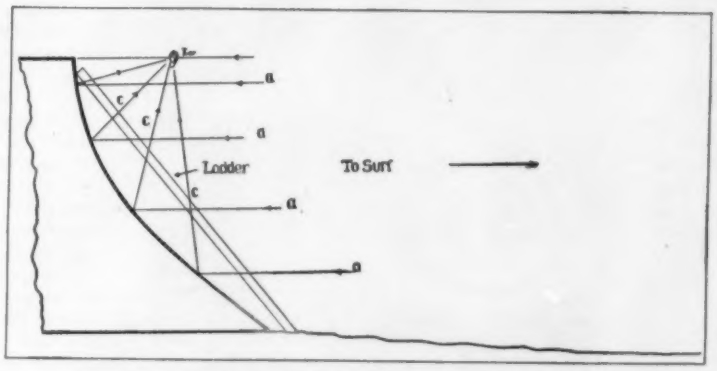
Giant Airship Propellers

THE accompanying photograph is liable to lead to some misconception. At first thought one would suppose that the automobile was being driven by the two giant windmills mounted on it. A moment's consideration, however, would demonstrate that the plane of these propellers lies parallel to the directions in which the machine should travel and consequently that they would tend to drive the machine laterally instead of forward. Of course these propellers have nothing to do with the operation of the automobile. They are merely a pair of airship propellers in transit from one of the large propeller plants in England. The picture gives some idea of the enormous size of propellers required for even a moderate sized airship.

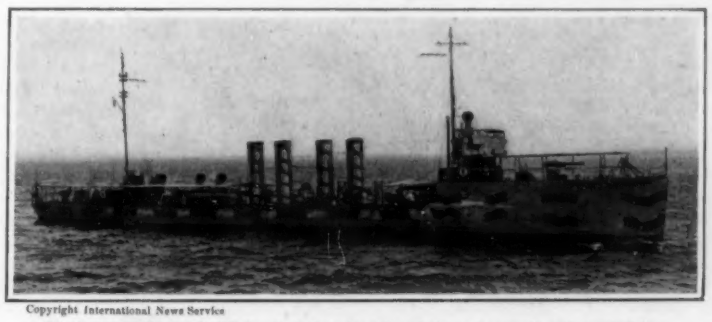


By courtesy of Aeronautics

Transporting a pair of airship propellers.



Galveston sea wall as a sound reflector.



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U. S. torpedo boat "Tripp" painted with stripes to render it invisible.

Copyright by Underwood & Underwood

A curious Alpine ambulance.

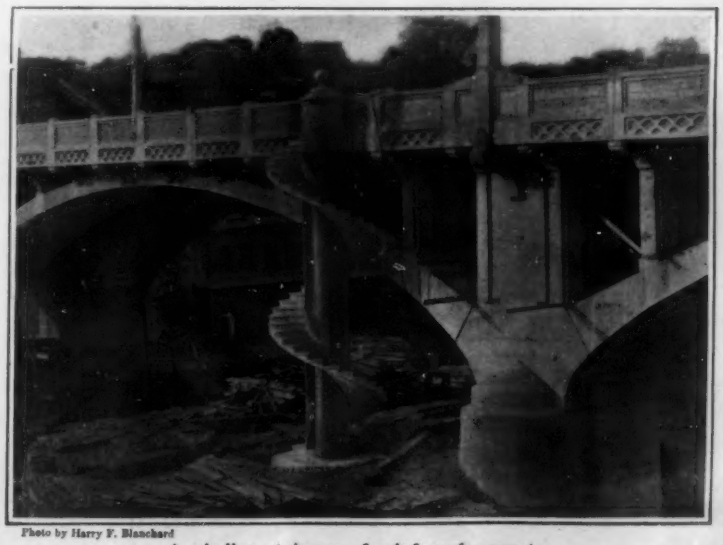


Photo by Harry F. Blanchard

A winding stairway of reinforced concrete.

An Instance of the Parabolic Reflector Reversed

By Leigh F. J. Zerbee

SECOND LIEUTENANT C. A. C. UNITED STATES ARMY.

THE relatively brilliant light projected from a small incandescent electric bulb when backed by a parabolic reflector in the headlight of a locomotive, interurban car, or automobile, is well known to all of us. If the beam of a light of this character is examined when it is projected through a fog, it will be seen that all the rays are parallel to each other, and that the beam is in fact a cylinder. The secret of the powerful illumination is in the fact that all the rays are concentrated in one direction. A mirror of any other shape will project a cone of light instead of a cylinder, and the cross-section of such a cone at any point ahead of the light is greater than the cross-section of the cylinder projected by a parabolic reflector. Therefore, the light being dispersed over a larger area, its intensity is less.

The converse of the foregoing is found in the reflection of sound waves from the Galveston sea wall. The vertical height of this wall is seventeen feet, and it must be ascended by means of a ladder or steps. The surface of the wall is a section of a parabola which is the same curve used in the reflector of modern headlights. The sound waves from the surf, which is a considerable distance from the wall, approach it sensibly parallel. On incidence they are reflected to the focus (the corresponding point to the filament in a light) and a greatly exaggerated sound of breaking waves is heard at this point.

Though at low tide a person ascending the ladder may be several hundred feet from the water, the roar of the surf when his ear reaches the focus is greater than when actually at the water's edge. The explanation, of course, is that his ear normally gathers only a small part of the total noise made, i. e., that part of the total wave motion which strikes the small area of his ear. The surface of the wall being so very much larger occupies even at its longer radius an arc of greater magnitude on the sphere of sound transmission than the ear at the water's edge. All the sound striking the wall is reflected to the focus. The sound at this point, therefore, is the sound that would be heard at the same distance from the surf if the ear were as long as the sea wall is high and of its actual width.

Putting the Light Under the Fender

AN illuminated fender has been patented, No. 1,145,087, to Edmond D. Shaw of Syracuse, N. Y., in which the front wheel fenders are provided with a depending flange bent to form a pocket, in which is held a signal light which sheds its rays forward through a suitable jewel or lens, and also illuminates the forward portion of the vehicle wheel.

Inventions New and Interesting

Simple Patent Law: Patent Office News: Notes on Trademarks

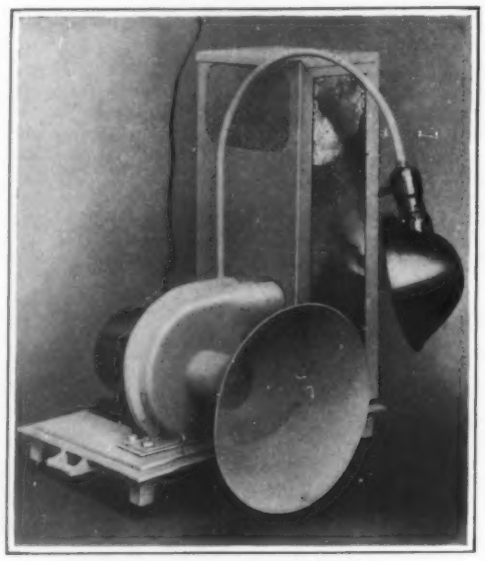
A Suction Fly Catcher

By Frank C. Perkins

THE accompanying illustration shows a fly catcher which operates on the principle of a vacuum cleaner. A powerful suction fan is driven by an electric motor, and the air, dust or insects that may be drawn into this fan are blown into a steel cage. Various types of mouth pieces are utilized with this machine, and extensions of 2-inch pipe can be made in any direction to catch flies, dirt or insects. A sponge is fitted into the top of the cages and water, from a little drip cup at the top of the cage keeps the sponge moist and makes it absorb the dirt in the atmosphere.

The electric light attached to the stand serves to attract insects at nighttime. During the daytime any sweetening material placed at the suction mouthpiece will attract the flies. Banana oil or banana peel, stale beer or molasses serve as good bait. The apparatus may be set in out of the way places and connected by a pipe to the spot that is to be protected from flies or insects.

The apparatus weighs approximately thirty pounds and it consumes about as much power as a 16 candle-power carbon lamp.



Suction device for trapping flies.

Measuring the Hardness and Elasticity of Rubber

SO different is rubber as a tire material, from all near substitutes, that one overhears not infrequently, the slogan "The only substitute for a rubber tire is another rubber tire."

Nor is this always true, for that group of physical properties that make rubber so invincible under severe road and other kinds of usage, may vary so that the next "rubber tire" may not only have rivals in near substitutes, but like them, will give discrepant service.

The time has come when rubber tires as an indispensable part of an automobile should be subject to standardization, if not in quality, at least in the control of physical properties, the peculiar combination upon which depends its fitness for a particular purpose.

It is not exactly known why, in rubber working, a pure raw material does not guarantee the finest finished article when subjected to a given heat treatment; obviously then, when a fine article *is* produced, it is not possible to tell without destroying it, just what the physical properties are which favor a given result and hence we go on no more enlightened than before. The two principal physical properties of rubber are hardness and elasticity, and instruments have now been devised for measuring these properties.

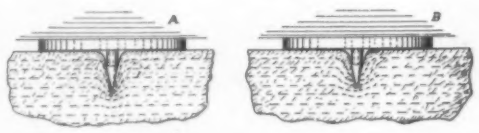
Hardness is measured in terms of resistance to depression of a plane surface by a standard spring pressing on a blunt pin. The surface is not broken in any event, and is therefore adaptable to finished articles.

The elasticity is measured in terms of resistance to permanent deformation. A moderately sharp pin is caused to penetrate a fixed depth and then is locked.

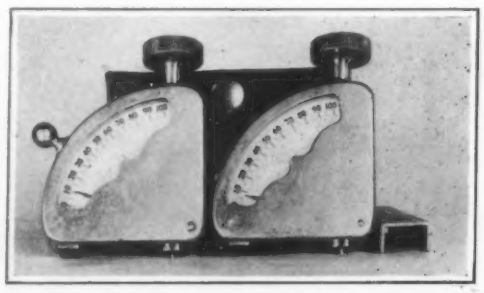
The relation of the edge of the point and the depth it is caused to penetrate has been carefully determined by discreet experiments on extremely elastic rubber. If the latter is quite perfect, no tearing or permanent injury results, and the point will be ejected completely upon unlocking it. The extent of the rubber's recovery after imposing this severe stress will then indicate such percentage of elasticity as will correspond with the older form of stretch test.

The new test has the advantage of being applicable to the plane surfaces of finished articles and practically leaves no visible mark.

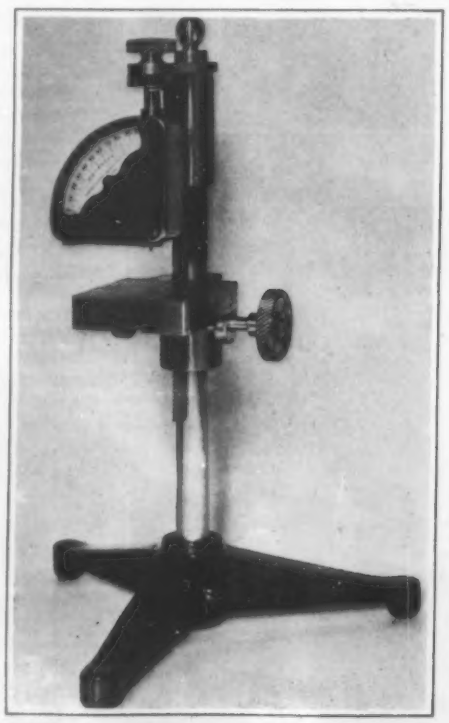
The importance of the measurement of the hardness and elasticity of the rubber can well be realized when it is noted that when so vulcanized the maximum elasticity is reached, and when then hardness is yet too low for most purposes, each degree of hardness gained is done so at a sacrifice of about three degrees of elasticity. So persistent is this loss of elasticity that when, for example, solid tires are hardened enough to carry the maximum loads often so much elasticity is lost that but very limited efficiency can be expected in service.



A, test for hardness; B, for elasticity.



Instruments for testing hardness and elasticity.



Measuring the hardness and elasticity of rubber.

Testing the Consistency of Asphalt

IT has been pointed out by Hermann W. Mahr of the New York Standard Testing Laboratory, that success in the laying of asphalt pavements is probably more dependent on the proper consistency of the asphalt cement used to bind the mineral aggregate than on any other feature. The varied origins of modern bituminous cements have made the determination of their consistency the most important test applied to these materials. Formerly a few varieties of standard solid bitumens, quite uniform in character, fluxed with definite proportions of petroleum residuums of standard and specified composition, yielding cements of a desired consistency, formed the bulk of the asphaltic cements, but recently many paving bitumens obtained by distilling asphaltic petroleums to the consistency of cements, have come on the market. Proximate chemical analysis is of little value in fixing their origin, and the highway chemist is obliged to rely almost solely on determinations of consistency to ascertain their suitability.

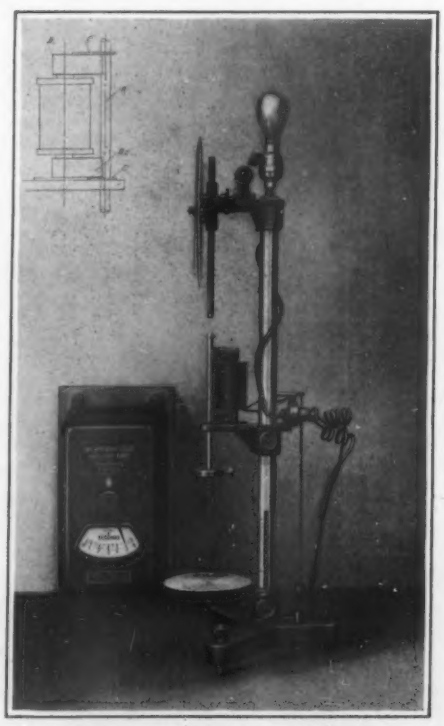
There have been used in the past a number of rough methods for determining the consistency of asphaltic cements, but the most generally used scientific determination is by means of penetrometers. The first of these instruments was devised by Bowen, and was followed by machines working on the same principle invented by Kenyon and Dow.

The machine consists essentially of a needle of specified size fixed in a rod, the rod and needle being of, or loaded to, definite weights. A clamp of some nature holds the rod with the needle, allowing the latter to penetrate as nearly as possible without friction. There is a device for measuring the amount the needle has penetrated after it has been released for a specified time and again grasped by the clutch, and the penetration is expressed in hundredths of a centimeter. Penetrations are most commonly made at 25 deg. Cent. (77 deg. Fahr.) with the needle loaded to 100 grammes penetrating for five seconds.

In order to ascertain the extent an asphaltic cement will harden when chilled to 0 deg. Cent. (32 deg. Fahr.), penetrations are frequently made at this temperature with the needle loaded to 200 grammes, penetrating for one minute. Occasionally it is specified that cements shall not show more than a stated penetration at 37.7 deg. Cent. (100 deg. Fahr.) or 46 deg. Cent. (115 deg. Fahr.), the needle being under a weight of 50 grammes and released for five seconds.

The penetrometer here illustrated is an improved type designed by the New York Testing Laboratories. It is electrically controlled and timed. The drawing shows the electromagnetic clutch utilized for holding the rod with its needle. The clutch is on a bracket sliding on the upright rod of the instrument, to which it may be secured by means of a set-screw. The weighted rod *A*, which holds the needle, is of steel, brass-clad. It slides through the openings in the thin German silver plates *C C*, and is partly inclosed by the concave poles B^1B^2 of the electromagnet.

It will be noted that the plates are set so the rod does not come into contact with the poles of the magnet, and are rounded where they touch the rod, thus eliminating all friction. The rod and needle weigh 50 grammes and are weighted to 100 and 200 grammes by weights of 50 and 150 grammes, respectively, slipped over the rod above the needle, and there fastened by set-screws. The penetration is measured, as in other machines, by means of a rack and pinion, the latter being fastened to an adjustable hand on a dial.



Machine with which asphalt is tested.

(*Concluded on page 238.*)

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Aviation.

SPEED CONTROLLER FOR AEROPLANES.—A. B. THAW, 640 Park Ave., New York, N. Y. This invention provides means for controlling within predetermined limits, the speed of an aeroplane; provides automatic control; augments or diminishes the speed of an aeroplane; and provides means for determining the action of the controller preliminary to landing.

Electrical Devices.

LIGHT UNIT.—A. D. NASH, Tiffany Furnaces, Corona, L. I., N. Y. The improvement provides a light unit which includes an electric lamp and a decorative globe containing the bulb of the light and having its neck detachably connected with an extension of the base of the lamp adjacent the bulb to leave the usual screw-threaded shank of the base wholly unobstructed for attachment to a socket.

ELECTRIC WHIP.—H. C. DIXON, care of Dixon Electric Whip Co., Shreveport, La. An object here is to provide means whereby an electric discharge may take place in such a manner that the animal will experience a pricking sensation, which while being sufficient to urge him into greater activity is not sufficiently intense to lead to injury. It may be used in lieu of an ordinary whip for causing a horse or mule to move at a faster pace, thus obviating the danger of injuring the animal.

Of Interest to Farmers.

SILO.—W. J. TOPLIFF. Address Cornie C. Moore, Unadilla, N. Y. The invention has for its general objects to improve and simplify the construction of silo door frames and door sections so as to be reliable and efficient in use, comparatively simple and easy to manufacture, and so designed that the door sections can be handled with facility.

MACHINE FOR CATCHING BOLL WEEVILS.—O. F. BLEDSOE, JR., Shellmound, Miss. The inventor provides a machine for catching boll weevils, having means for readily adjusting the height of the pans which are held yieldingly spaced apart to pass at each side of the plant stems, the pans being pivoted to swing together laterally as occasion may require.

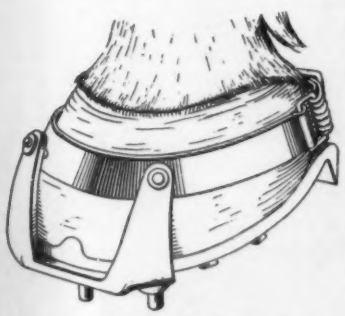
Of General Interest.

VAGINAL SPECULUM.—L. DROSIN, 1666 Lexington Ave., New York, N. Y. A particular object of this invention is to provide a weighted speculum so constructed that in certain cases of rectocele, lacerated perineums, or the like, it may be so adjusted as to hold itself in place without danger of slipping, as the ordinary speculum sometimes does.

STREAM DEFLECTOR.—W. H. DEAN, 4611 Altoona St., Sioux City, Iowa. The invention relates to stream deflectors for use in rivers and other waterways, and provides a deflector arranged to cause the current in the waterway to form a building current and to prevent the current from digging into the shore or bank of the waterway.

STAIN REMOVING COMPOSITION.—G. A. STEVENOT, 280 Baltic St., Brooklyn, N. Y. The invention provides a composition which may be readily put up in such form as to be especially adapted for household use. The composition will quickly and thoroughly remove stains of various kinds, iron rust and the like, without injuring textile fabrics and other material.

TOE CALK FOR HORSESHOES.—W. GORDON, 1743 N. 8th St., Philadelphia, Pa. The invention relates to improvements in calk attachments for horseshoes and has for an object to provide a simple construction which can be easily applied to and removed from the



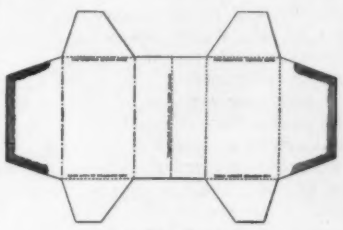
TOE CALK FOR HORSESHOES.

horse's hoof, and will, when in place, be securely held against displacement in any direction and will embody means which will aid in the adjustment of the attachment to hoofs of different size and shape.

RACKING DEVICE FOR VATS.—A. GREPPO, 1 Rue Saint-Claude, Paris, France. This device is particularly for the purpose of fitting to the lower or inner end of the draft tube inlet member and cup-shaped stopper, these members being adapted to retain the greater part of the solid substances which might be found in suspension in the liquid to be racked, such stopper being at the same time adapted to be screwed alternately to the inlet member and to the inner end of the tubular bung.

COFFEE CLEARING COMPOUND AND PROCESS OF MAKING SAME.—J. MORLEY, 903 30th Ave., Seattle, Wash. The invention refers to a composition of matter or compound for the purpose of clearing coffee previous to drinking the same, and the object is the provision of a compound of the above character which will considerably improve the taste of the coffee.

MAILING DEVICE.—J. M. CRULL, 304 North St., Harrisburg, Pa. This invention relates to inclosures for mail matter, and the main object thereof is to provide a sheet of such form as to adapt it for use as two distinct envelopes for letters, as a return envelope combined with the outgoing envelope, and as a wrapper for newspapers, etc. The blank may be formed from any desired material, of any size and of any weight.

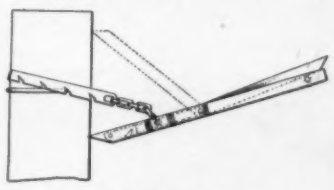


MAILING DEVICE.

Hardware and Tools.

SELF-LOCKING HINGE.—F. H. ROBINSON, 374 Empire Ave., Fort William, Ontario, Canada. The invention relates to hinges and to an automatic or self-locking hinge, and provides a construction whereby a door may be held by the hinge in an open or partially open position. It provides a hinge in which locking members are provided, designed to be readily thrown into and out of operation in order to hold the door in an open position.

WIRE STRETCHER.—W. N. ROSE, 3119 Virginia St., Houston, Texas. This stretcher is arranged to draw a fence wire against the back of a post in a manner to produce a transverse bend in the wire partly embracing the post. The wire is then secured by a tie or anchor wire fastened across the front of the post.



WIRE STRETCHER.

The stretcher includes toothed hook bars to lie at the sides of the post and engage the wire, the bars being connected by chains with a vertically rocking lever that is placed with its front end against the front of the post. A brace bar is pivoted to swing against the post to hold the wire under strain while being tied.

Heating and Lighting.

SIPHON BLOWER.—J. L. HOUSTON, 21 Mill St., Poughkeepsie, N. Y. This invention has reference to siphon blowers or material ejectors especially adapted for furnaces, economizers and the like, whereby ashes, soot, fine coal and other material can be discharged quickly, effectively, economically, and with a minimum of labor.

ELECTRIC HEATER.—E. B. RYCE and WILLARD WALLACE. Address the latter, 121 N. 5th Ave., Louisiana, Mo. This invention provides a device by means of which water or other liquids can be heated in a minimum amount of time with a minimum amount of electrical energy. The device may be used as a heater for general purposes, not only for liquids.

Household Utilities.

FOLDABLE WARDROBE.—FRANCES MACDANIEL, Oceanville, Maine. This invention provides a wardrobe more especially designed for use in camps, small rooms and other places, and arranged to permit of readily folding it to form a small bundle for convenient shipment from one place to another and to allow of quickly setting it up whenever it is desired to use it.

LEAF FOLDING MECHANISM FOR TABLES.—A. RENZETTI and L. RENZETTI, 302 E. 44th St., New York, N. Y. The invention relates particularly to means for folding the extra leaves provided therefor. It provides a mechanism for unfolding and again folding the extra leaves of the table when the permanent parts of the table are moved back and forth in an opening and closing movement.

Machines and Mechanical Devices.

TYPE WRITING MACHINE.—S. M. MANN, Greenville, W. Va. The invention relates more particularly to type writing machines, including variable spacing means, the object being to provide means whereby three different spacings may be accomplished, one of which is equal to the ordinary spacing between letters, and the other two of which are respectively one half of the usual spacing and and one one half times the usual spacing.

PEANUT HULLER.—L. T. LILLEY and R. C. LILLEY, Gatesville, N. C. The invention is an improvement in peanut hullers, and has for its object the provision of a machine of the character specified, by means of which the nuts may be hulled and cleaned and delivered from the machine in a marketable condition.

Musical Devices.

VIOLIN BOW.—FRANK J. STECKENREITER, Calyer and Jewell Sts., Brooklyn, N. Y., N. Y. The invention relates to musical instruments and has particular reference to the construction and musical effects of bows commonly used upon violins, cellos and the like. It improves the means for facilitating the renewal of the hair, and furthermore, to provide a means for maintaining the hair in proper shape adjacent the frog.

SOUND BOX.—E. H. KAUFMAN, 130 Claremont Ave., Bronx, N. Y., N. Y. This invention relates to sound reproducing and recording instruments, and more particularly to a sound box having a stylus bar, a diaphragm, and means for supplying an air current to the sound waves produced by the diaphragm whereby the sound waves produced at the diaphragm by the stylus bar are intensified.

RECORD DISK.—A. ETTLINGER, 80 Maiden Lane, New York, N. Y. This invention relates to graphophones and similar machines, and its object is the provision of a new and improved record disk provided with means for quickly and accurately centering the opaque record disk on the centering pin of the revolving platform of the graphophone.

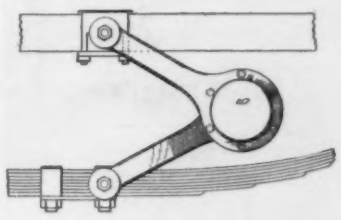
Pertaining to Recreation.

COMBINED SPONGE CUP AND CHALK HOLDER.—E. SCHLOSSBERG, 1007 Metropolitan Ave., Brooklyn, N. Y., N. Y. The invention provides an inexpensive sponge and chalk holder combined, in which the holder is detachable from the sponge cup, and which holder forms a retainer for the sponge within the cup whereby the same cannot be detached from the cup unless the holder is removed.

ELECTRICAL AMUSEMENT DEVICE.—W. PRINA, 101 Summit Ave., West Hoboken, N. J. This invention has particular reference to that character of devices employed generally at public amusement places and involving a certain element of chance. It provides a device of unusually attractive form because of the representation of a baseball diamond and field, and provides in connection therewith peculiar electrical connections.

Pertaining to Vehicles.

SHOCK ABSORBER.—C. J. ANDERSON, Melrose, Ore. The invention relates to improvements in shock absorbers for vehicles and has for its object to check and prevent shocks and jolts due to excessive vibration and oscillation



SHOCK ABSORBER.

of the body member of a spring supported vehicle incident to the wheels of the vehicle passing over uneven places or obstructions in a road, and also to provide an easy and uniform running motion to the vehicle.

DRAFT WHEEL.—W. L. OLSON, 246 Massachusetts Ave., Detroit, Mich. Mechanism is provided adapted to be quickly mounted on the rear axle of a motor car in place of the ordinary wheel, or to be demounted therefrom, and wherein the mechanism is so arranged that the power of the motor is transmitted to the wheel at a considerable reduction in speed, thereby increasing the traction power of the motor and the vehicle in like proportions.

ELECTRIC DOOR UNLOCKING AND OPENING AND CLOSING MEANS FOR AUTOMOBILES.—K. W. KURTZ, 39 The Mowry, Syracuse, N. Y. This invention pertains to door opening and closing means especially adapted for automobiles or other vehicles, whereby the driver can, by the mere closing of the circuit switch, cause the door or doors to be opened or closed without the necessity of the driver leaving his seat.

AUTO ATTACHMENT.—H. KEPLER, Devils Lake, N. D. The main object in this case is to provide means for preventing the axle end, or any part of the automobile, from touching the ground in the event of a wheel coming off; and among other objects one is to so construct the said means as to serve as a runner, in the event of a wheel coming off, whereby the automobile may be hauled to a suitable place for repair.

RESILIENT TIRE.—H. HAUS, Pope Valley, Cal. The object of this invention is to provide a simple, strong, inexpensive and efficient resilient tire which will respond readily and uniformly to variation of loads thereon that may be caused by the unevenness of the road or sudden obstacles that may come across the wheel.

HAME.—N. KELSAY, Evansville, Ind. This improvement relates to hames for harness and more particularly to means for adjustably connecting the trace loops of hames, whereby to adjust the line of draft up and down on the hames to accommodate the hames to animals of varying size.

Designs.

DESIGN FOR A BRACELET.—J. COHN, Address Morris Grossman, 309 Broadway, New York, N. Y. In this instance the ornamental design for a bracelet is shown in an edge view, a front elevation view thereof, and in a fragmentary sectional view on a line in the front elevation view.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

NEW BOOKS, ETC.

THE WAR TERROR. Further Adventures With Craig Kennedy, Scientific Detective. By Arthur B. Reeve. New York: Hearst's International Library Company, 1915. 8vo.; 376 pp.; illustrated. Price, $1 net.

This is not a book on the war, and has, in fact, very little to do with war. It is a loosely threaded string of detective stories in which criminal and captor call all the resources of modern science to their aid. The ultra-violet ray, the spintharioscope, the smoke helmet, the microphone, electrolysis and psychanalysis follow one another through the pages in rapid succession. The collection is readable and more or less instructive, though the tense atmosphere of the ideal mystery tale is lacking. Some of this lack may be due to the author's practice of giving the clue to the secret in his chapter heading.

PRACTICAL SHOP MECHANICS AND MATHEMATICS. By James F. Johnson. New York: John Wiley & Sons, Inc., 1915. 12mo.; 130 pp.; illustrated. Price, $1 net.

This new volume in a technical series for vocational and industrial schools is well adapted to forward the progress of the student in the simpler branches of applied mechanics and related mathematics, in so far as these branches come into contact with actual shop conditions. The experience of the author, both in shop practice and in teaching, is a guarantee of the close correspondence between his instructions and the student's real needs. He endeavors to dispel the element of mystery in which shop mechanics are usually shrouded, and his effort is crowned with a gratifying measure of success.

THE MODEL T FORD CAR. Its Construction, Operation and Repair. By Victor W. Pagé. New York: The Norman W. Henley Publishing Company, 1915. 300 pp., cloth; over 100 specially prepared diagrams and halftone illustrations, two folding plates. Price, $1.

Many general treatises on the automobile have been written, but this probably is the first time that an entire publication has been devoted to an exhaustive description of one particular car; but this is undoubtedly justified, and desirable, because of the large number of these cars that are in the hands of the public, and especially those who care for their own cars; and these are just the ones who should thoroughly understand the mechanism they are handling. The book is written by a mechanical engineer who has owned and driven one of these cars for a number of years and understands them intimately, both theoretically and practically; and he knows just what information other owners seek and should have. The majority of the illustrations have been prepared by the author himself, so they can be relied on to show clearly and accurately the points described, and they cover practically every portion of the mechanism in considerable detail. Besides covering the why and wherefore of every part of the car, simple and clear instructions are given for adjusting, overhauling and repairs, as well as hints on driving; and the book would certainly prove a money saving investment to every owner of one of these cars.

Chain Screen Doors for Oven and Furnace Openings

(*Concluded from page 233.*)

glowing with heat arrives before the chain screen shield, protecting the furnace it pushes boldly through the same. When once the truck and its pot have passed through the chains the latter close together, protecting the workmen from the radiant heat and the new pot from drafts of cold air.

The work of setting the new pot and walling it in is then performed with this transparent shield intervening between the men and the glowing masses, insuring comfort and consequent rapidity of the operation, and the avoidance of considerable cooling, which always takes place where the old forms of sheet iron shields and doors are used.

Glass workers all know how great a heat rushes from the uncovered furnace. Measured on the thermometer it shows a temperature of over 600 degrees, yet when one of these chain screens is placed in front of the opening the temperature is lowered to such an extent that one may hold his bare hand within an inch of the protecting transparent screen without danger or discomfort.

Testing the Consistency of Asphalt

(*Concluded from page 236.*)

The counterweight and spring, used in the previous types of instruments for holding the rack in place, are dispensed with. The pinion shaft has an additional gear wheel. This gear is in mesh with a worm on a shaft at right angles to the first, the worm shaft being driven by means of a milled head at one side of the dial. By turning the milled head the rack may be raised or lowered and accurately set on top of the rod. In setting the needle on the surface of the sample, the latter is first raised to within less than a millimeter of the former. The rod is then forced down by the rack until the needle touches the surface of the asphaltic cement.

While setting, the rod is held by the magnet, the electro-magnetic force being overcome by that exerted by the rack. This device and method of procedure enable very accurate settings of the needle and rack to be made. The sample is placed on a movable shelf which can be rapidly lowered to allow cleaning of the needle. In order to set the machine in a vertical position, a plumb bob and adjusting screws are attached to the penetrometer. A small electric lamp, fastened to the top of the standard and in series with the electromagnet, indicates when the current is on. The instrument is wound to be connected to a 110-volt direct-current circuit.

It is claimed that the use of the electromagnet clutch precludes the shock or displacement of the machine, due to a clamp operated by hand. The circuit is broken by pressing a button. To eliminate the time error of the observer, a Sieman's intermediate relay with time-limit is used. The penetrometer is placed in the circuit with one side of this device, and the lighting circuit passed through a switch and the relay electro-magnet. On breaking the current through the latter, the penetrometer circuit is broken and automatically made at the end of five seconds.

The Current Supplement

A VALUABLE article in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2071, for September 11th, 1915, is on the measurement of the distances of the stars, and reviews in an unusually interesting manner the efforts of early astronomers in this direction, and describes the modern methods employed in this important work. While the irrigation projects being carried out in this country are generally supposed to be of exceptionally great extent, it may be news to many that the work of the government in India far exceeds in magnitude and engineering difficulties anything that we have yet attempted; and the areas in that country that have been reclaimed, and the benefits attained are surprisingly great. The article on this subject in the present issue gives an interesting account of some of these works, together with a number of excellent illustrations. The article on the experimental study of the mechanism of writing deals with some investigations made in the interest of the new science of experimental pedagogy. The valuable paper on military explosives is concluded. Some notes on agriculture in Germany, and facts about the potash industry of that country give interesting details. For a long time efforts have been made to devise some system of signaling to and between vessels at sea, using the water as a medium, instead of the air, to warn them of dangers, and considerable progress has been made. There is an excellently illustrated article telling about various methods and experiments, and describing the operation of some recent devices. The care of exceptionally bright children takes up an important educational question that should receive more careful attention by the public. Balata gum has become an important substance in several lines of industry, being to some extent a substitute for caoutchouc. There is an illustrated description telling how this material is gathered in the interior of South America and brought to market. The electrostatic ore separation is a comparatively new process, and the article treating of the process and describing methods of operation will be of interest generally. Another valuable article describes the efforts that have been made to substitute artificial light for sunlight in the treatment of surgical tuberculosis, and a number of typical cases involving this method of treatment are discussed.

The Vitamines, and Their Importance for the Maintenance of Health *

UNTIL recently it was thought possible to determine the value of food from its content of proteids, fats, carbohydrates, and nutrient salts. This view is erroneous, as much disastrous experience has proved.

It is necessary to take account also of certain substances, which are called vitamines because of their importance, and even indispensability, to life. Their presence in food was detected, not by refined methods of chemical analysis, but by the study of certain diseases, especially beriberi.

Beri-beri is endemic in all communities which are fed entirely with hulled rice, sago, and white bread. The first symptom, loss of appetite, is followed by increasing fatigue, diarrhœa, and loss of weight. Then come paralytic symptoms and muscular atrophy, beginning in the lower limbs, enlargement of the right side of the heart, difficulty in breathing, blueness of the skin, scanty urinary secretion, œdema, and finally death, after a few weeks or months. The disease is never contagious, due to bacteria or accompanied by fever. It is rather, as we now know, a chronic disturbance of nutrition, caused by a diet deprived of vitamines, and it is quickly cured by food rich in vitamines, such as fresh vegetables, raw fruit, raw milk and eggs, and raw or half-cooked meat. It can be produced with certainty in fowls and pigeons by feeding them exclusively on white bread or polished rice. Birds thus fed exhibit typical symptoms of beri-beri and soon die, unless bran, beans or some other similar article is added to their diet.

In countries where rice is the principal food beri-beri first appeared when it became customary to remove the unsightly reddish brown hull and polish the grain to glossy whiteness. In the same way the disease appeared in Europe when and where white flour was substituted for dark flour made of whole grain. An epidemic of beri-beri among Norwegian fishermen was caused by using bread made of bolted rye flour instead of whole rye bread.

* Condensed from Dr. Reinhardt's article in *Prometheus*.

In all grains the vitamines, as well as the proteids, fats, lipoids and nutrient salts, are found in the outer layer, immediately under the cellulose hull. When the hull and the bran are removed all of these valuable substances are lost. The bran is fed to animals, which need it less than human beings do.

The structure of maize is like that of other grains. Persons who live almost entirely upon hulled maize, spoiled by being kept in a damp place, are subject to a chronic poisoning, which is indicated by indigestion, foul mouth, diarrhœa, cutaneous eruptions and severe nervous symptoms which resemble those of beri-beri. Tremors, cramps, paralysis, œdema, exhaustion and death follow, unless fresh whole maize, fruit, vegetables, and potatoes are added to the diet. This is the disease which is known in Italy as pellagra. In southern Italy and northern Africa a very similar disease, called lathyrism, is caused by an almost exclusive use of spoiled peas as food, and is cured by fresh vegetables and fruit, raw milk, etc.

The longest-known disease caused by deprivation of vitamines is scurvy, which was formerly common on long sea voyages, in war, in besieged cities, and in cases of failure of the potato crop. Scurvy begins with pallor, painful swellings in legs, inflamed and putrid gums, palpitation and weakness of the heart, dispnoea, emaciation and muscular atrophy, which are followed by hemorrhage, ulceration, diarrhœa, œdema and death. A complete cure can be effected in two weeks by administering green vegetables and fresh fruit. The lives of thousands of sailors have been saved by lime juice. Scurvy is caused by the exclusive use of dried vegetable substances, including grain, flour and bread, sterilized and preserved meat and milk. A variety of the disease, called infantile scurvy or Barlow's disease, is produced by feeding infants on sterilized milk. The symptoms are similar to those of scurvy in adults. A cure can be effected in two or three weeks by feeding raw milk, fresh vegetables or fruit, the juice of grapes, oranges or lemons, and the freshly expressed juice of meat.

Boiled milk, and especially repeatedly heated milk, cause also that peculiar malnutrition of the bones in children that is known as rickets, and they increase the tendency to convulsions. Breast-fed children are practically free from both of these diseases, which attack nearly all and kill many children fed on boiled cow's milk. Milk and all other food, including meat, eggs, fruit and vegetables, are thoroughly wholesome and rich in vitamines only when raw. The vitamines are destroyed partially by drying, and more completely by cooking. All grains and seeds used as food should be crushed or ground and eaten whole, including the hull, which contains, in addition to the proteids, fats and nutrient salts, the vitamines which are so important for the preservation of health.

[While the statements of this writer are in the main correct, there are some that do not hang together. Beri-beri is said to be caused by excluding the hulls of grain, which contain the vitamines, but vitamines are destroyed by cooking, so there would appear to be little difference in food value between white bread and whole wheat bread, or between boiled brown rice and boiled white rice, as far as vitamines are concerned. Also if pellagra results from the use of spoiled maize, it would appear of little consequence whether it was hulled or not.—Note by Editor.]

A Road Surface for the Automobile Wheel

PETER F. HABERSTICK of Wheeling, W. Va., has patented No. 1,144,540 as an emergency device, a casing in advance of a traction wheel and containing a tape whose end may be attached to the wheel so that forward rotation of the wheel will draw the tape out from the casing and form a surface on which the wheel can operate.

INQUIRY COLUMN

READ THIS COLUMN CAREFULLY. You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. There is no charge for this service. *In every case it is necessary to give the number of the inquiry.* Where manufacturers do not respond promptly the inquiry *may* be repeated.
MUNN & Co., INC.

Inquiry No. 9429. Wanted the name and address of a manufacturer of a machine for bleaching beeswax.

Inquiry No. 9430. Wanted the name and address of a manufacturer who can supply machinery for producing soluble coffee.

Inquiry No. 9431. Wanted to purchase a mold for shaping and piercing beads made of rose leaf of the consistency of dough.

Inquiry No. 9432. Wanted the name and address of a manufacturer of watch glasses 9 inches in diameter.

Inquiry No. 9433. Wanted the name and address of a manufacturer of a material such as is used by gas mantle makers. The material is used to cover the wire frame that supports the mantle at the top and is used to protect the wire from the flame or heat of the mantle.

Inquiry No. 9434. Wanted the name and address of a manufacturer of special pins, 1/16 of an inch in diameter and ¾ of an inch long, the pins to be made of bone.

Inquiry No. 9435. Wanted the name and address of a manufacturer who can furnish grinding machines for the hollow grinding and finishing of razors. Up-to-date machines wanted.

Inquiry No. 9436. Wanted the name and address of a manufacturer of rat traps having a receptacle attached into which the rat drops and drowns.

Inquiry No. 9437. Wanted the name and address of a concern that can make an oil or grease gun. West preferred. Must be able to make in quantities of 10,000.

Inquiry No. 9438. Wanted the name and address of a manufacturer of light aluminium sheets, small tubing, rods and wire, also aluminium solder.

Inquiry No. 9439. Wanted the name and address of a manufacturer of a knitting machine which was on the market some years ago. The name of the machine was the Bickford Machine. It was a hand knitting machine, weighing about 15 pounds.

Inquiry No. 9440. Wanted the name and address of a concern selling Dr. Young's E-Z Sanitary Belt.

Inquiry No. 9442. Wanted the name and address of a manufacturer of a machine for cutting skeins of cotton and wrapping each bundle around the middle with wire. A machine of some such kind is used in the brush trade for wiring and cutting to length the bundles of bristles for paint brushes.

Inquiry No. 9443. Wanted the name and address of manufacturers of fuel oil burners and fire wall equipment, suitable for a maximum quantity of water evaporation in a locomotive firebox of the following dimensions: 2½' between door and flue sheet, 3' between grate level and crown sheet, 3' between side walls.

Inquiry No. 9444. Wanted the name and address of a manufacturer or patentee of a glass preserving jar made for use with air pumps for creating a vacuum.

Inquiry No. 9445. Wanted the name and address of a manufacturer who can make a combination pencil holder and point protector.

Inquiry No. 9446. Wanted the name and address of a manufacturer who can supply machinery for automatically wrapping cigars in thin imported tissue paper having the ends tightly wound and curled. Would consider purchase of machines or patent rights.

Inquiry No. 9447. Wanted to buy patented article, which is needed in every home, with a possible view to manufacturing and distributing.

Inquiry No. 9448. Wanted to get in touch with manufacturers who can make small gasoline motors and parts thereof. Must be able to handle considerable orders with expedition.

Inquiry No. 9449. Wanted the name and address of a manufacturer who is prepared to build a new and very simple stationary engine with or without gas producer.

Inquiry No. 9450. Wanted the name and address of a manufacturer who can build a light simple motor for light automobiles and for portable farm work.

Inquiry No. 9451. Wanted the name and address of a manufacturer of machinery for making egg albumen.

Inquiry No. 9452. Wanted the name and address of a manufacturer making machinery for the production of Tannic Acid from the Mangrove plant.

Inquiry No. 9453. Wanted the name and address of a maker of a machine for washing and drying bristles; also machine for cutting, combing and assorting bristles.

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(13073) H. T. W. asks: Although I have access to five sets of encyclopedias and six astronomical textbooks, I am unable to find out the candle-power of the moon. Are you able to give me information on this point? If so, I shall be most grateful to you. A. We have never seen the candle-power of the moon given in any textbook. An approximation may be had by comparison with that of the sun. Young's "Manual of Astronomy," (which we send for $2.50) Sections 210 and 265, gives the light of the sun as compared with that of a standard candle at the distance of the sun as 1575×10^{24}, or 1575 followed by 24 ciphers. The moon's light varies greatly because of the variation in the transparency of the atmosphere. The estimates for the full moon at its brightest vary from 1/300,000 to 1/800,000 of that of full sunlight with the sun overhead. The figure usually taken is that of Zollner, 1/618,000, or in round numbers, 1/600,000. On this basis the full moon gives 2625×10^{18} times as much light as would be given by a standard candle at the distance of the sun from us. If the candle were at the distance of the moon its light would be increased about 160,000 times, and the moon's light would then be about 164×10^{14} times that of a standard candle at the distance of the moon. Another way to express it is to take the brightness of the sun as compared with a standard candle at a meter distance. The candle-power of the sun is by experiment found to be about 70,000 on this basis. Divide this by 600,000 and you have about 7/60 of a candle as compared with the candle at one meter distance. These are rough approximations only. We have not attempted a careful solution of the ratios.

(13074) J. J. F. asks: Please inform me, when an automobile is going around a curve, which wheel leaves the ground—the outer or the inner? Does the same apply to a railroad train on a track going around a curve? A. A vehicle of any kind turns over toward the outer side of the curve, when it is overturned by rounding the turn too fast. This is the effect of the centrifugal force produced by the high velocity of the vehicle. The name centrifugal means fleeing from the center. As the pressure of the vehicle is outward, the outer wheels press harder on the ground or rails than the inner, and the vehicle overturns upon the outer wheels as a center. Thus the inner wheels must leave the ground first.

(13075) H. H. M. asks: Would you kindly inform us how many cubic inches there are in an imperial gallon? Our present records are as follows: J. W. Adams gives 277.274; Kent, 277.274; Haitte (a German authority) 277.2738, but mentions in 1890 another number, 277.463; W. & L. E. Gurley give in their book, 277.410. I am very anxious to have the correct measurements as per present dating scientific reckoning, and as I am a regular subscriber to your valued magazine, thought you would be the best authority to apply to. A. The Smithsonian Physical Tables (Price $2.00), sixth edition, table 3, page 9, gives the British imperial gallon as 4.5459631 liters, and on page 8 the cubic decimeter is given as 61.02390 cubic inches. The liter is a cubic decimeter. The product of these two numbers will be the number of cubic inches in an imperial gallon. This is 277.4123976 cubic inches. The remaining figures are not reliable, being rendered inexact by the unknown figures in the factors beyond those which are given. This is, as you see, practically the number employed in the Gurley book.

(13076) L. W. G. asks: 1. A little less than four years ago I had a solar heater installed in my house. The heating unit, located on the roof under glass, consists of about 150 feet of ¾-inch galvanized iron pipe arranged with return bends to form a flat coil. This spring the coil started to leak through about a dozen small round holes which had rusted through the pipe. Those holes were not on the seam of the pipe, but at different points around the circumference, and in several different lengths. The water here has considerable mineral matter in it. Is it likely that electrolysis could have caused the holes? A. It does not seem necessary to call in any stray current to explain the corrosion of your heating pipe. Four years is rather a short time for a pipe to rust through, but if there were thin places in the pipe when it was put in, the chemical action might be able to eat it through in that time. 2. Would the comparatively high temperature of the water in the coil tend to hasten any electrolytic or purely chemical action? A. The high temperature of the water would hasten the corrosive action. The mineral matter in the water would increase the number of ions and thus tend to make the chemical action more rapid. 3. Would it be possible for electrolysis to occur if a telephone wire only ran near a cold water pipe without actually grounding on it? A. The current in the telephone line near the pipe could not affect the pipe at all. 4. If a telephone wire were grounded on a cold water pipe, would there be sufficient current to cause electrolysis of the pipes? A. If the telephone wire were grounded on the water pipe, electrolysis would take place only where the current left the pipe, which would not be in the air but in the ground where there was an easier path back to the central for that current.

(13077) W. F. S. writes: Referring to Answer to Query 13071, I beg to adivse that this statement, according to text books on mechanics of materials, is incorrect. Steel is 78.7 times "stiffer" than water in resisting change of volume due to pressure. Water therefore becomes dense at a more rapid rate than steel under water head, and if the ocean were deep enough it would "float" at a certain depth. The exact depth cannot be computed, however, for we do not know enough about the elastic properties of steel and water under such enormous pressures of submergence. Just a few days ago I figured that cast-iron will "float" at a depth of 33.7 miles. I computed this as closely as I could. Steel, though, will sink to a considerably lower depth before it will float, because it is both stiffer and heavier than cast-iron. A. Your criticism of our Answer to Query 13071 involves two points. The first: Your assertion that water may at sufficient depth become as dense as steel, so that steel would float in water at that depth. We are unable to reach this conclusion. The Smithsonian Physical Tables, sixth edition, published in 1914, contains on page 79, the coefficient of compressibility of water for several temperatures and for pressures from 1 to 3,000 atmospheres. The compressibility at 0 deg. Cent., and from 1 to 25 atmospheres is 0.0000525 per atmosphere. As the pressure increases, the compressibility diminishes, until at 0 deg. Cent. and 2,500 to 3,000 atmospheres the compressibility is 0.0000261—less than half as much.

Placing the results in tabular form, we have:

Pressures in Atmospheres.	Coef. × 10^6 at 0 deg. Cent.	Diff.
1 to 500	47.5	59
500 to 1,000	41.6	58
1,000 to 1,500	35.8	34
1,500 to 2,000	32.4	32
2,000 to 2,500	29.2	31
2,500 to 3,000	26.1	

Three thousand atmospheres corresponds to a depth of about 20 miles. By taking the differences of the coefficients, it is seen that the diminution of compressibility is not uniform, but in a decreasing series. That is, there is probably a pressure beyond which water cannot be further compressed. There is little probability that it should be continually compressed by an increase of pressure. It should be noticed that the compression is very slight even at 3,000 atmospheres. Sir John Murray, in his recent work, "The Depths of the Ocean," on page 246, gives the actual density of the water at a depth of 4,000 meters, or about 2.5 miles, as 1.04621, or only 1¾ per cent denser than at the surface. Now steel is 7.6 times as heavy as water. Considering these figures, it is impossible to conclude that water can ever become as dense as steel and that any depth can be found at which steel will float in water. The second criticism is well taken. Steel is not more compressible than water. Our error arose from misplacing the decimal point in the coefficient of the compressibility of steel. The Smithsonian Tables give the coefficient of the compressibility of steel per atmosphere as 0.00000068. If we divide the greatest compressibility of water by this number, we have for a quotient 77 and a small fraction. We do not know which increases more rapidly in density under pressure, steel or water, since we have no figures for steel at different pressures, similar to those for water. But it may be safely said that steel is not compressed uniformly as the pressure is increased and that there is a limit to its compressibility. In a recent number of the *Proceedings* of the National Academy of Sciences, a series of new determinations of the compressibility of the elements was published. We have not seen this as yet. We cannot believe that cast-iron can float at a depth of less than 34 miles in ocean water. We do not find that your statement that cast-iron is lighter than steel is in accordance with our data. The Smithsonian Tables, page 84, give the densities of various forms of iron as follows: Pure iron, 7.85 to 7.88; white cast, 7.58 to 7.73; gray cast, 7.03 to 7.13; steel, 7.60 to 7.80. The difference in the densities of iron and steel is too small to make any great difference in their sinking in water. Both would go to the bottom of the ocean with a considerable velocity. We thank our correspondent for calling our attention to our numerical error and its consequences.

(13078) A. G. T. asks: Will you kindly advise me if there is any theory relating to the action of the crystal rectifying detector and where I can procure same if there is? A. The crystal detectors operate by presenting a higher resistance to the alternating current impulses in one direction than to those in the opposite direction. The current thus becomes direct with half as many impulses as the alternating current from which it originated. No satisfactory theory for this peculiar action has been advanced. The subject is discussed in Pender's "American Handbook for Electrical Engineers," which we send for $5.

(13079) C. O. W. asks: Are all living cells necessarily germs? Could a bone cell or a tissue cell properly be called a germ? In other words, do the two words, *cell* and *germ*, have exactly the same meaning? A. A germ cell is a cell with peculiar possibilities. If fertilized, it develops into an embryo, and becomes finally like the parent from which it originally came. A cell from a piece of bone has no such possibilities. If a bone is injured the cells adjacent to the injury do not propagate other bone cells and thus join the broken ends together. New cells are formed from material which the animal develops in the gap between the broken ends, and the union is thus completed. All living cells are not germ cells.

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